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SUMMARY OF EXISTING WATER, SEDIMENT, FISH, AND SOIL DATA
IN THE VICINITY OF THE OAK RIDGE RESERVATION

August 18, 1983

Introduction

On April 26, 1983 the Tennessee Division of Water Management requested TVA's assistance in reviewing existing surface water data in the vicinity of the Oak Ridge Reservation. TVA subsequently received a majority of the data from Oak Ridge Operations on June 16. Water, sediment, and fish data (primarily from 1970 through July 1983) were examined for East Fork Poplar Creek, Poplar Creek, Bear Creek, White Oak Creek, Clinch River, and a segment of the Tennessee River (Figure 1). Recent soil samples from the Oak Ridge area were also examined. The primary purposes were to synthesize available offsite* data; evaluate data adequacy for defining specific problems; and determine what additional data are needed.

With the exception of three areas, this review indicated that existing offsite data are generally insufficient to define specific actions other than further sampling and assessment. The three areas of most obvious immediate concern are East Fork Poplar Creek, White Oak Creek, and Jefferson Junior High School. In East Fork Poplar Creek, mercury concentrations in fish exceed the Food and Drug Administration action level, indicating that the State's decision to ban fishing is appropriate. In White Oak Creek, increases in radioactivity during the last few years suggest a continuing source of radioactivity that should be identified and evaluated. At Jefferson Junior High School, soil concentrations of mercury were higher than at any other offsite sampling

51
88
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*Department of Energy facilities were not included in this review.

location. Because both mercury concentrations and human activity are high at this site, an immediate assessment of the potential health impact and the extent of contamination should be initiated.

Scope of the Review

Available water, sediment, fish, and soil data were obtained from a variety of sources (Tables 1 and 2). Twenty chemical and radiological parameters were examined (Table 3). Data on groundwater, air quality, effluent discharges, plant and animal conditions, and onsite areas were generally not examined. With the exception of limited PCB data, no information was available for toxic organic compounds.

The available data were reviewed with respect to the following questions:

- o What contaminants are present in offsite surface waters and soils and at what levels?
- o Where are the highest concentrations?
- o How do these concentrations compare with background levels and existing criteria and standards?
- o Are concentrations increasing or decreasing (i.e., continuing releases and temporal trends)?
- o What additional data is needed to define specific problems and corrective actions?

Chemical Parameters in Water, Sediment, and Fish

Table 4 summarizes the number of water, sediment, and fish samples available for each chemical parameter. This constitutes a substantial data base for overviewing surface water conditions. It is less useful in developing specific conclusions because the data is widely scattered

among 44 fish species, 14 years (1970-1983), and six streams (East Fork Poplar Creek, Poplar Creek, Bear Creek, White Oak Creek, Clinch River, and Tennessee River).

Summary statistics were examined for each parameter by stream, river mile, year, and fish species (summaries are available in a separate appendix). Mean concentrations are compared with available criteria and background levels in unpolluted streams in east Tennessee (Tables 5 through 11). These comparisons indicate varying degrees of elevated levels for mercury, chromium, copper, lead, nickel, and PCBs (Table 12).

Water concentrations of mercury and chromium in East Fork Poplar Creek are sufficiently elevated to warrant further analysis. Sediment concentrations of mercury, chromium, copper, lead, and nickel in East Fork Poplar Creek, Poplar Creek, and the Clinch River are generally above background concentrations (Table 13). Concentrations of mercury, chromium, nickel, and PCBs in fish also exceed background levels (Tables 8 and 14). Zinc shows no abnormal levels in the available data for water, sediment, or fish. For other parameters, such as beryllium and toxic organics, the data are insufficient (Table 12). Further sampling of these parameters is needed.

Mercury Concentrations in Water, Sediment, and Fish

Data provided by the Department of Energy indicate that the major discharges of mercury occurred in the late 1950s and early 1960s (Figure 2). As indicated above, the current level of mercury in sediment and fish in some areas is significantly above background levels. For water concentrations, recently observed levels in East Fork Poplar Creek are near or below detection limit values (e.g., Figure 3). Since most of the recent data were reported at a detection limit generally above the EPA criterion

for the protection of aquatic life, a conclusion regarding current discharges to East Fork Poplar Creek is not possible.

Mercury concentrations in sediment are highest in East Fork Poplar Creek, with a mean concentration exceeding 45 µg/g in the upper reach. Concentrations decrease with downstream distance to approximately 1.0 µg/g in Watts Bar Reservoir (Figures 4 through 12). Limited data for Bear Creek and White Oak Creek have an average concentration of approximately 2.0 µg/g. Background concentrations in unpolluted streams in east Tennessee generally range from 0.05 to 0.2 µg/g. The data are not sufficient to define temporal trends (Figure 13).

Sediment concentrations of mercury in the Tennessee River upstream of the Clinch River average 0.27 µg/g. Mean concentrations downstream of the confluence are significantly above this level through Nickajack Reservoir (Table 15).

These observations suggest the need for core sediment sampling from East Fork Poplar Creek through Guntersville Reservoir, including Bear Creek and White Oak Creek. The sampling should include an analysis of particle size distribution, deposition dating, and variations in mercury concentration with depth. This information will allow an analysis of sediment transport and a determination as to whether the Clinch River is the source of elevated downstream mercury concentrations.

Mercury concentrations in fish follow a pattern similar to that in sediment. Concentrations are highest in East Fork Poplar Creek and decrease with downstream distance (Figures 14 through 16). Concentrations in East Fork Poplar Creek average 1.1 µg/g for all species and 1.2 µg/g for all bluegill, exceeding the Food and Drug Administration action level of 1.0 µg/g. Concentrations in Poplar Creek, the Clinch

River, and the Tennessee River (immediately downstream of the Clinch River) are generally below the FDA action level, but above background concentrations. Concentrations are higher for larger fish with some observations exceeding 1.0 $\mu\text{g/g}$ (Figures 17 through 27). In Bear Creek and White Oak Creek, limited data show mean concentrations of 0.36 and 0.65 $\mu\text{g/g}$, respectively. Examination of the data by stream reach for selected species by year indicates no obvious temporal trend (Figure 28).

Based on these data, further sampling is recommended for larger fish of selected species (i.e., bottom feeders) in Poplar Creek, Bear Creek, White Oak Creek, the Clinch River, and Watts Bar Reservoir.

Mercury Concentrations in Soil

Mercury concentrations in soils and dredged sediments in the Oak Ridge area were measured in recent months. As of August 1, 1983, TVA had received 182 sample results from 15 identifiable areas. The locations appear to be somewhat random and dictated more by reports of dredge material placement than systematic sampling. The results indicate elevated concentrations in several areas (Table 16 and Figure 29). The highest concentrations are at Jefferson Junior High School (i.e., the mean concentration of 125 $\mu\text{g/g}$ in one set of data compares with expected background levels of less than 0.5 $\mu\text{g/g}$). Since the potential for human activity in this area is high, an immediate assessment of the potential health threat and areal extent of contaminated soil should be initiated. Other areas of lesser concentrations should also be examined, as well as other areas of high human activity which may have been the recipient of contaminated dredge materials. Selected sampling of East Fork Poplar Creek, Poplar Creek, and Clinch River floodplains and their plant and animal populations is also recommended.

Radiological Parameters in Water, Sediment, and Fish

Discharges of radioactivity to White Oak Creek reached a peak in the late 1950s and generally declined since that time (Figure 30). More recent data show above background levels in the Clinch River downstream of the mouth of White Oak Creek at CRM 20.8 (e.g., Figure 31 for Sr-90). Data for Cs-137 and H-3 show similar results. Concentrations since about 1978 have generally increased, but the cause is not clear (e.g., river flow rates, sediment resuspension, groundwater leachate, or sampling inconsistencies). Although no public water supplies are located on the Clinch River below Melton Hill Dam, the reach is classified for domestic and industrial water supply. If water was regularly consumed from the Clinch River near the mouth of White Oak Creek, doses could be in the range of natural background levels (150 mrem/year). Based on the elevated concentrations observed, the stream classification, and the possibility of a continuing release (e.g., groundwater leachate), sampling and analyses should be conducted to determine whether continuing releases exist, their significance, and possible corrective actions.

Cesium has a greater tendency to be concentrated in fish than tritium or strontium. Figure 32 illustrates reported concentrations in selected fish species at various locations in the Clinch River during 1978. The highest values occur at the mouth of White Oak Creek (CRM 20.8). A person who regularly catches and eats fish from this area would be expected to receive only low additional radiation doses from Cs-137 compared to those from natural sources. However, since concentrations are elevated in this area, further data and analysis of the possible combined radiation dose and its significance is recommended.

In 1962 and again in 1977 sediment cores were collected at CRM 7.5. Results of the 1962 analysis are shown in Figure 33 (fig. 3, ORNL-3721, Supp 2B). At CRM 7.5, the river is turning slowly to the left such that most of the sediment and deposited radioactivity is located from about 200 feet to 450 feet from the left bank on the inside of the turn. The 1977 study collected sediment at locations of 40 to 150 feet from the left bank. As the 1962 study indicates, relatively low activities were found in these locations. Thus, it appears that at this one river location, the highest activity sediment may not have been sampled in 1977.

The highest activity in 1962 sediment core samples 4, 5, 6, and 7 occurs at depths of about 4 feet and decreases at both shallower and deeper levels. This may indicate that most of the radioactivity measured in these core samples came from Cs-137 which peaked in 1956 (Figure 34--fig. 6, page 24, ORNL-3721, supp 2B). Since the levels of highest activity are generally deep in the sediment, they are somewhat isolated from fish and reentrainment in water.

Data on the radioactivity in bottom sediments were collected by Oak Ridge National Laboratory from 1954 through 1961 at many locations on both the Tennessee and Clinch Rivers. Cs-137 data from 1961 are shown in Figure 35 (table 8, page 65, ORNL-3721, Supp 2A). The Clinch River, upstream from White Oak Creek, has a Cs-137 sediment activity of slightly greater than 1 pCi/g. From the entrance of White Oak Creek to the Tennessee River, the activity ranges from about 40 to over 100 pCi/g. Figure 36 (fig. 9, ORNL-3721, Supp 2A) shows Cs-137 concentrations in bottom sediment in 1961 at different locations in the Tennessee River. The activity upstream of the entrance of the Clinch River is about

1 pCi/g but rises to over 30 pCi/g immediately downstream of the Clinch River. The activity decreased with increasing downriver distance until background levels were reached in the Kentucky Reservoir. Data from the 1977 sediment study were not collected for the same locations, but appear to follow the same general trend.

In 1978 and 1979 the sediment in both White Oak Lake and White Oak Creek from the lake to the Clinch River was sampled and analyzed for concentrations of several radionuclides. Radionuclide concentrations are elevated in both locations. Figure 37 (fig. 15, page 43, ORNL-5878) gives an average of Cs-137 concentrations in various depths of sediment samples collected downstream of White Oak Dam. The highest concentrations, near the surface, are about 50 Bq/g or about 1300 pCi/g.

A study of the radionuclides in the sediment of the East Fork Poplar Creek was conducted in 1974. This study found only very low concentrations of uranium. The study also measured mercury concentrations in the sediment and found only low concentrations. Studies conducted since 1974 of mercury in soils and sediment from this creek have found higher mercury concentrations. Data since 1974 from limited radionuclide studies of these soils and sediments are not sufficient to conclude that there are not also high uranium concentrations.

For plutonium, above background concentrations exist in some sediments in the Clinch and Tennessee Rivers. Slightly elevated concentrations are also measurable in both fish and water. However, because concentrations are low and because ingested plutonium is not efficiently incorporated into the body, calculated doses are less than 0.1 percent of the natural background dose.

Limited data are available on radionuclides in Bear Creek. These data do not indicate a significant radiological hazard.

Based on these observations, any offsite areas suspected of being contaminated by dredge material from East Fork Poplar Creek, Bear Creek, or White Oak Creek should be examined for fission products, uranium, and plutonium. Excessive concentrations may suggest mitigative actions. Such an evaluation may require new sediment analyses to ensure that areas of highest concentrations are considered.

Major Conclusions

Mercury and Other Trace Contaminants:

1. East Fork Poplar Creek--Mercury concentrations in fish generally exceed the FDA action level. Sediment concentrations are substantially above background levels. Alternative corrective actions should be evaluated. Additional data are needed to identify trends. Concentrations of chromium, nickel, and toxic organics in fish and sediment should be examined further.
2. Poplar Creek and Lower Clinch River--Mercury concentrations in fish and sediment are above background levels. Additional data are needed to identify trends and determine whether concentrations for specific fish species exceed the FDA limit. Additional data are also needed for chromium, nickel, and toxic organics.
3. Bear Creek and White Oak Creek--Limited data for fish and sediment indicate that mercury levels may be elevated. Additional data for mercury and toxic organics are needed to define the levels present and their significance.
4. Tennessee River--Sediment samples downstream of the Clinch River show elevated mercury levels, at least as far downstream as Nickajack

Reservoir. Core samples from Watts Bar, Chickamauga, Nickajack, and Guntersville Reservoirs are needed to determine concentration variations with depth, past trends in deposition, and whether the Clinch River is the source of this mercury.

Offsite Lands:

5. High mercury concentrations were found in soil samples from some areas in the vicinity of Oak Ridge. Detailed sampling of these areas is needed to determine the areal extent of significant contamination. Each area should be examined to determine whether corrective actions are necessary.
6. Areas suspected of containing dredge material from DOE facilities, East Fork Poplar Creek, Poplar Creek, White Oak Creek, Bear Creek, or the Clinch River should be sampled for mercury, toxic organics, and radioactivity. Floodplains and their indigenous populations should also be sampled.

Radiological Contaminants:

7. East Fork Poplar Creek, Poplar Creek, and Bear Creek--Insufficient data are available. Screening samples of water, sediment cores, and fish should be obtained to more accurately determine the levels present.
8. White Oak Creek and Lower Clinch River--Available data indicate that radioactivity exceeds background concentrations. Significant increases observed in Clinch River water concentrations during recent years are inconsistent with reported releases over White Oak Dam. Seepage from low-level burial sites may partially account for this increase. The significance of the elevated levels observed in water, sediment, and fish needs to be examined further.

9. Tennessee River--Sediment samples downstream of the Clinch River show radioactivity above background concentrations. The levels, which decrease moving downstream and may be slightly elevated as far as Pickwick Reservoir, are not believed to pose a threat to public health.

SUMMARY OF ASSESSMENT
AND MITIGATION PLANS

- I. Evaluate existing data and related information
 - A. Surface waters (water, sediment, fish, biota)
 - B. Groundwater - onsite and offsite
 - C. Wastewater sources and discharges
 - D. Land (soil, plant, animal) - onsite and offsite
- II. Prepare comprehensive offsite assessment plan
 - A. Data collection and routine monitoring
 - B. Data analyses
 - C. Transport and fate
 - D. Risk assessment
- III. Prepare comprehensive onsite assessment plan
- IV. Initiate data acquisition/monitoring programs and subsequent analyses as identified in the comprehensive plans
- V. Evaluate alternative corrective actions
- VI. Develop mitigation plan
- VII. Implement mitigation plan
 - A. Corrective actions
 - B. Followup analyses of mitigation success

ENVIRONMENTAL MONITORING AND ASSESSMENT
KEY ELEMENTS AND OBJECTIVES

I. Data Collection

- A. Historic--contaminant identification and time periods
- B. Screening--detect abnormal concentrations
- C. Detailed--areal extent of excessive levels
- D. Routine--regulatory compliance, trend assessment, and abatement success

II. Data Analysis

- A. Assessment--significance of observed levels
- B. Transport and Fate--mechanistic transport, food chain uptake
- C. Recommendations--evaluate controls, cleanup, health impacts

III. Risk Assessment

- A. Public Health--potential impacts to man
- B. Environs--potential environmental impacts

ADDITIONAL DATA NEEDS

- o Review historic information on materials handling and disposal.
- o Assess onsite disposal sites.
- o Characterize wastewater discharges.
- o Standardize future routine monitoring.
- o Sample selected fish species from East Fork Poplar Creek through Chickamauga Reservoir.
- o Collect core sediment samples from East Fork Poplar Creek through Guntersville Reservoir.
- o Identify possible toxic contaminants present and include scans and specific measurements in fish and sediment analyses.
- o Evaluate existing groundwater data and conduct additional monitoring as necessary.
- o Perform detailed sampling of highly contaminated land areas and screening sampling of areas of suspected contamination.

Appendix I - Figures

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8	Poplar Creek Sediment Data
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- 36 Cs-137 in the Tennessee River, 1961
- 37 Cesium-137 Content in White Oak Creek Sediment, 1978
Sampling Program

OAK RIDGE VICINITY MAP

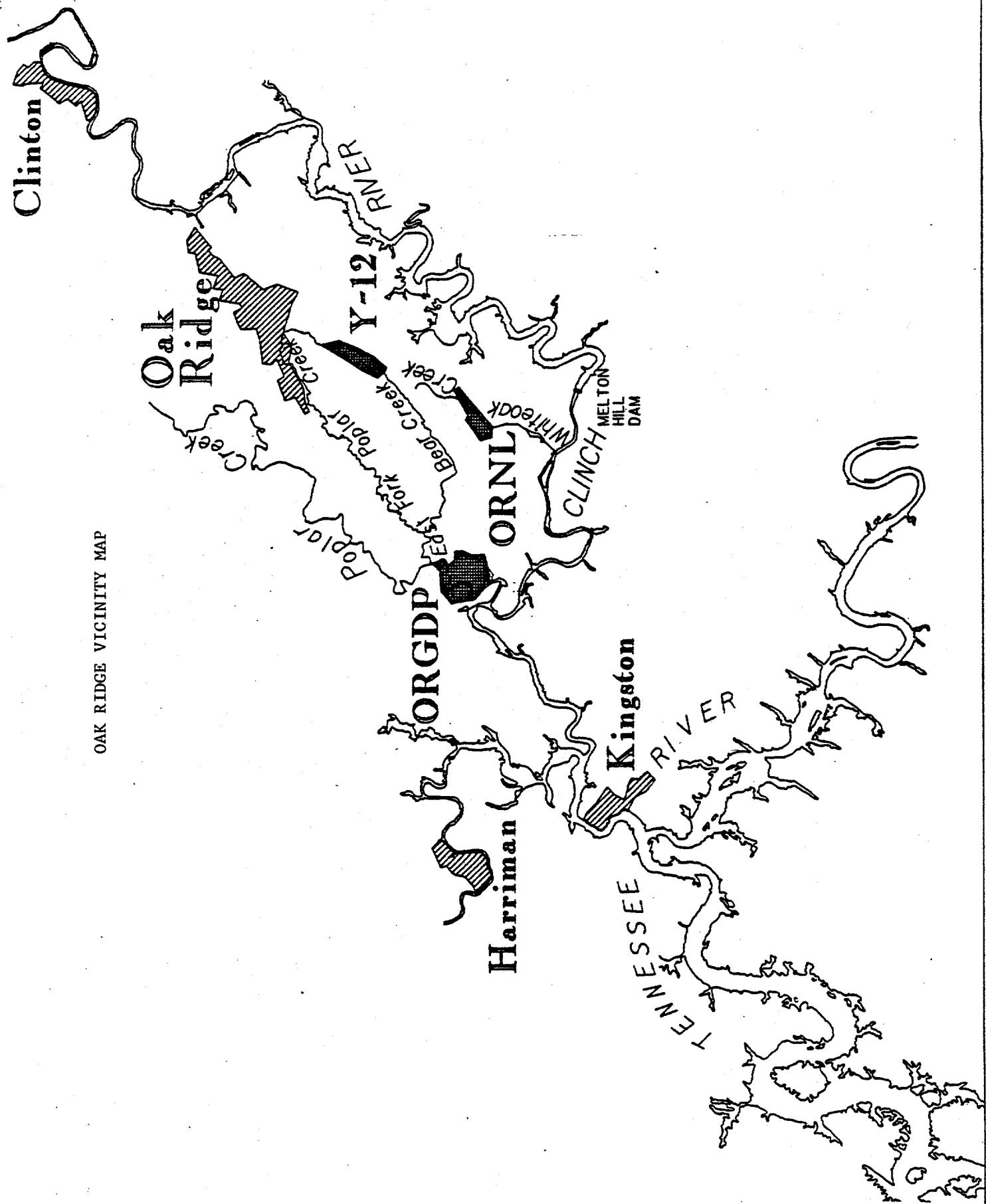


FIGURE 1

MERCURY LOSSES TO EAST FORK POPLAR CREEK

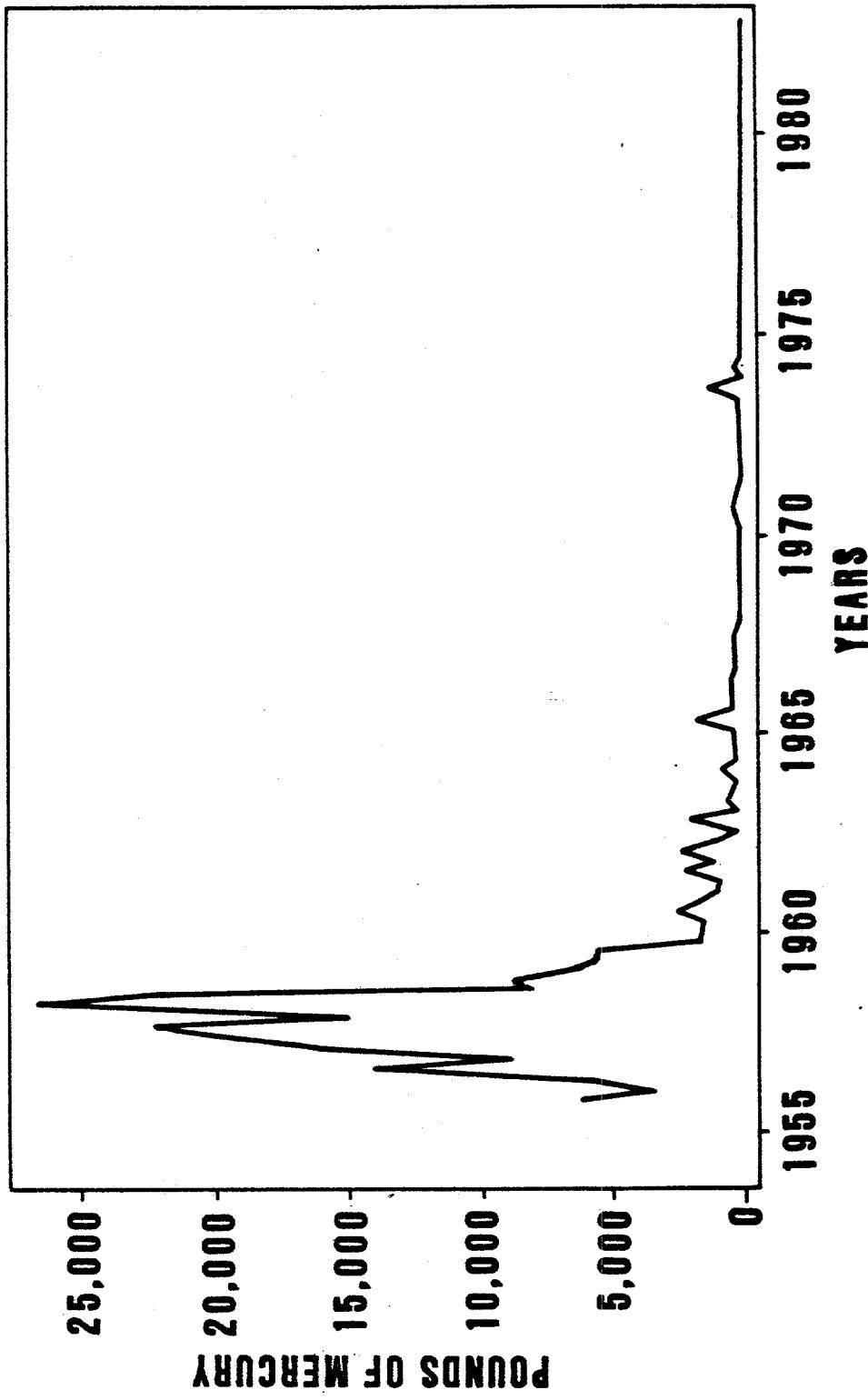


FIGURE 2

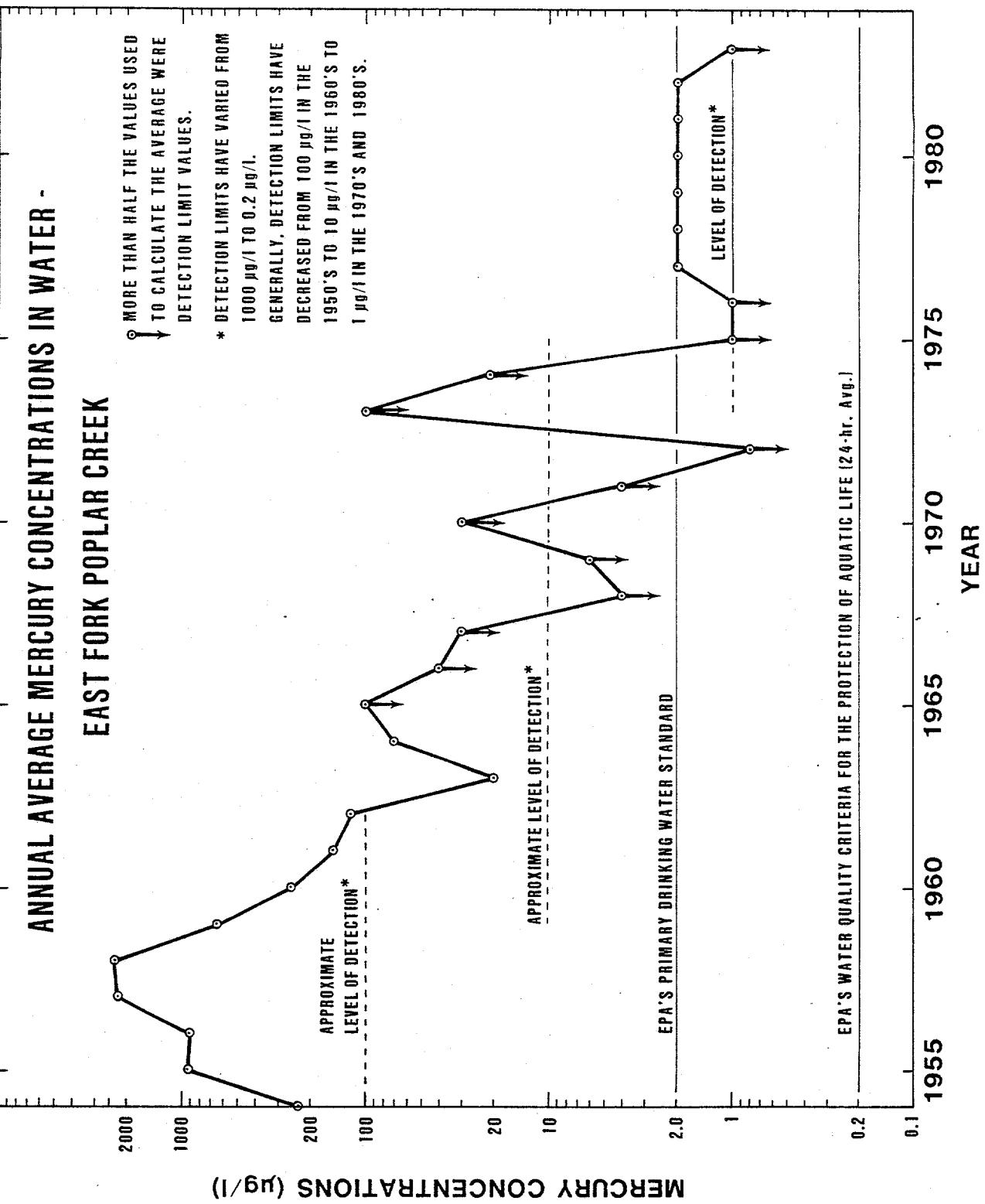
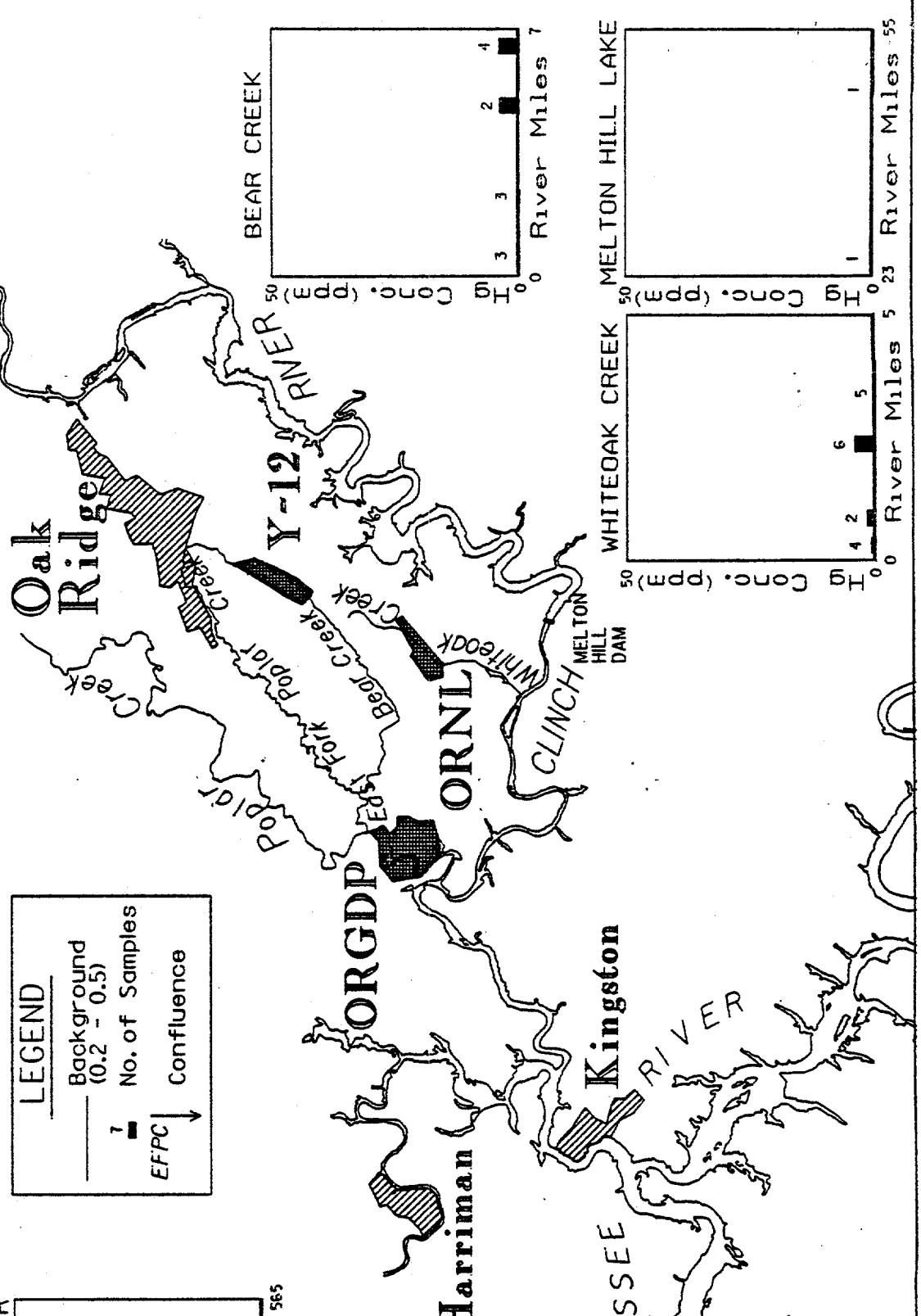
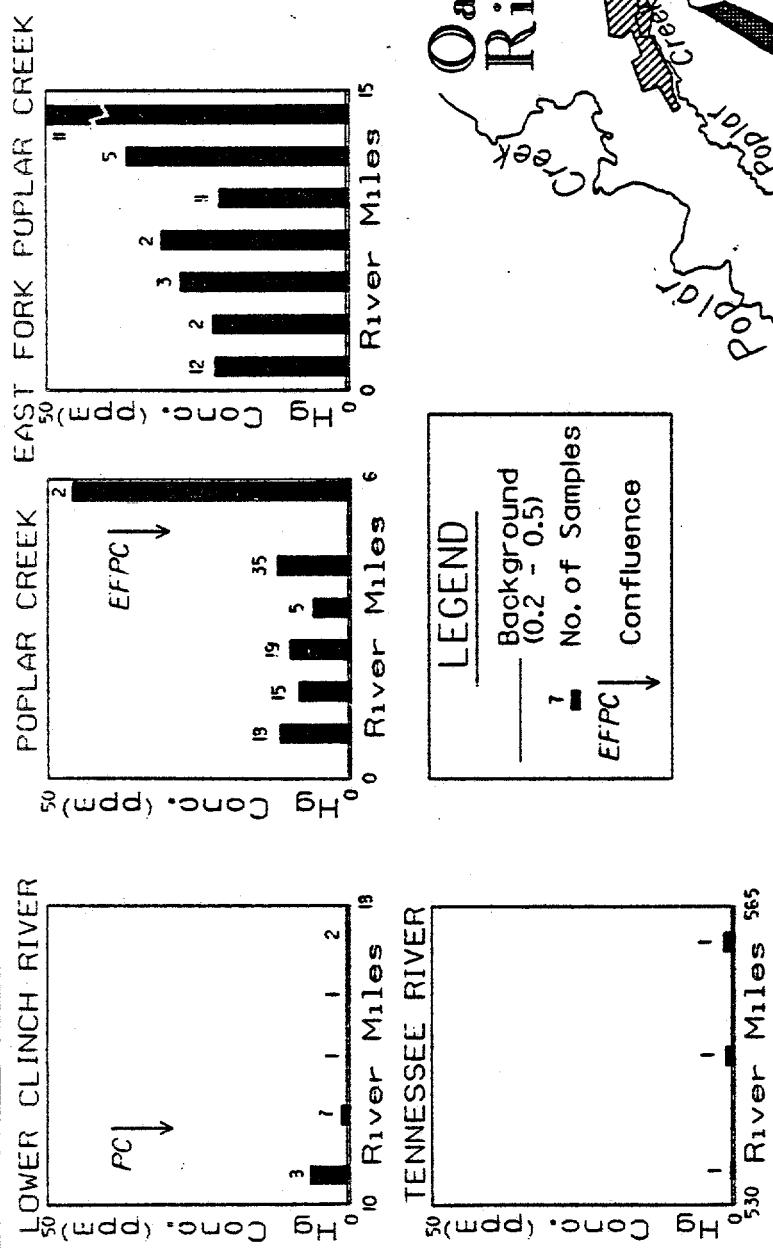


FIGURE 3

Mercury Conc. in Sediment



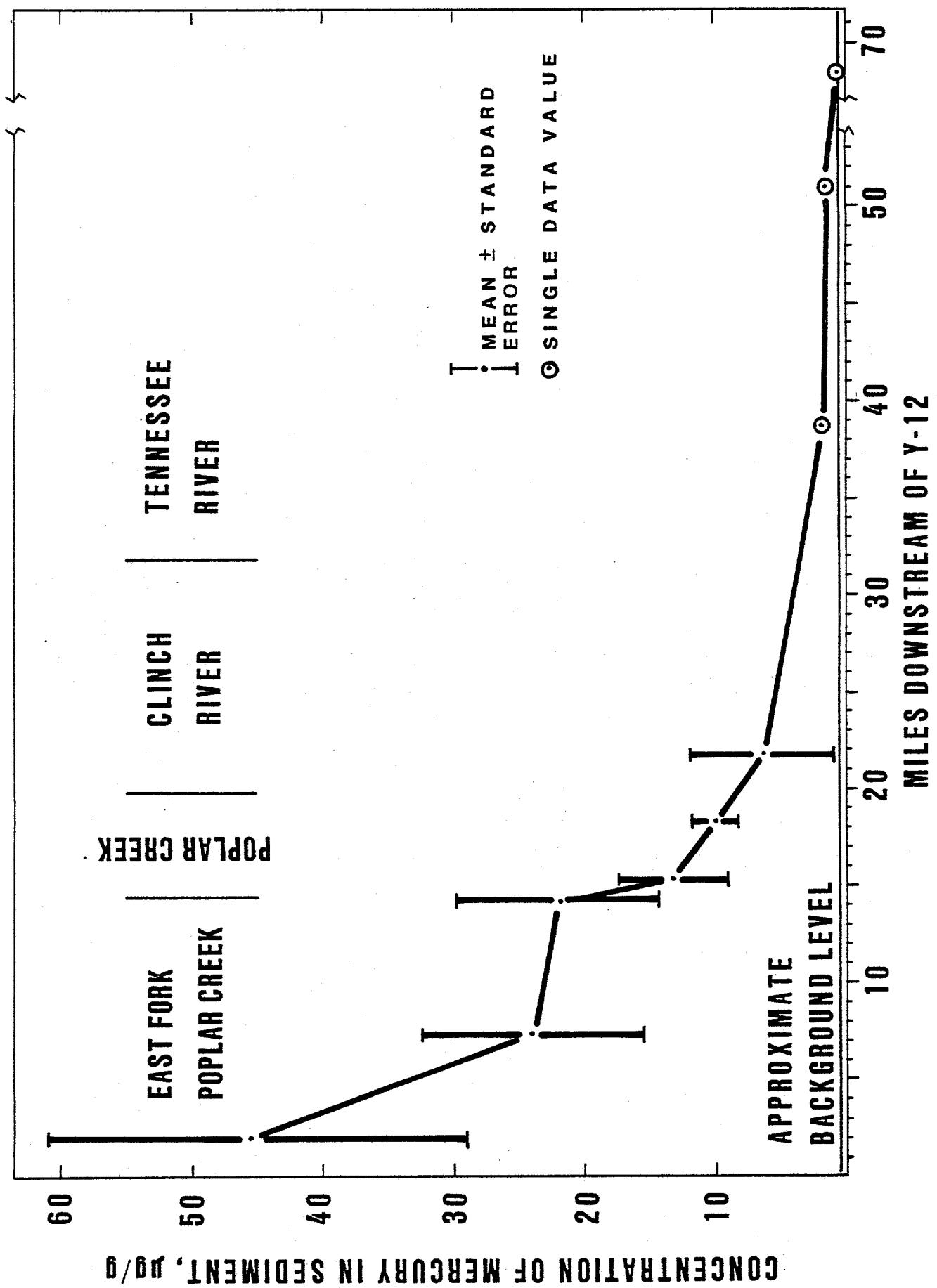


FIGURE 5

UPPER CLINCH RIVER SEDIMENT DATA

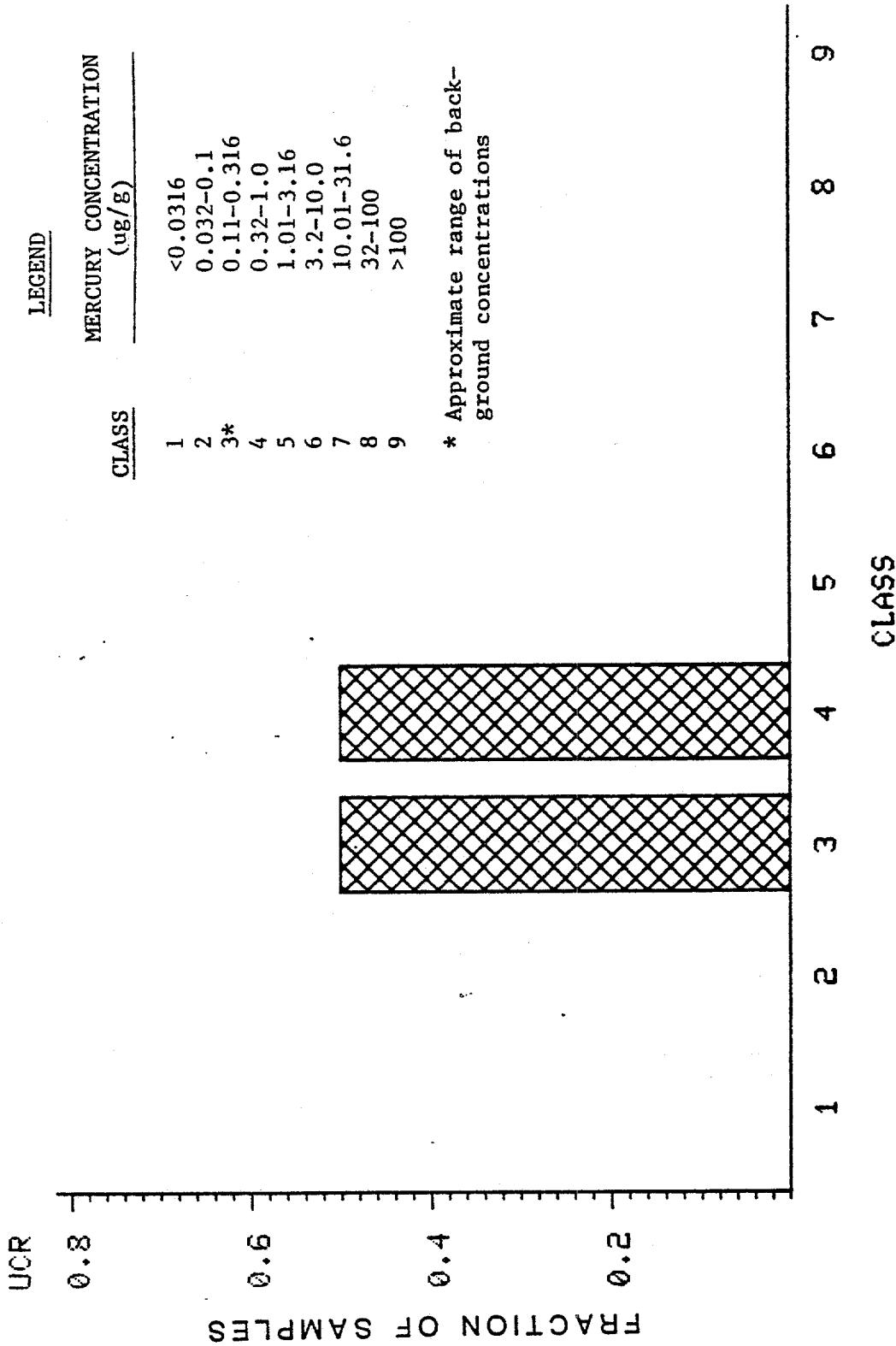


FIGURE 6

EAST FORK POPLAR CREEK SEDIMENT DATA

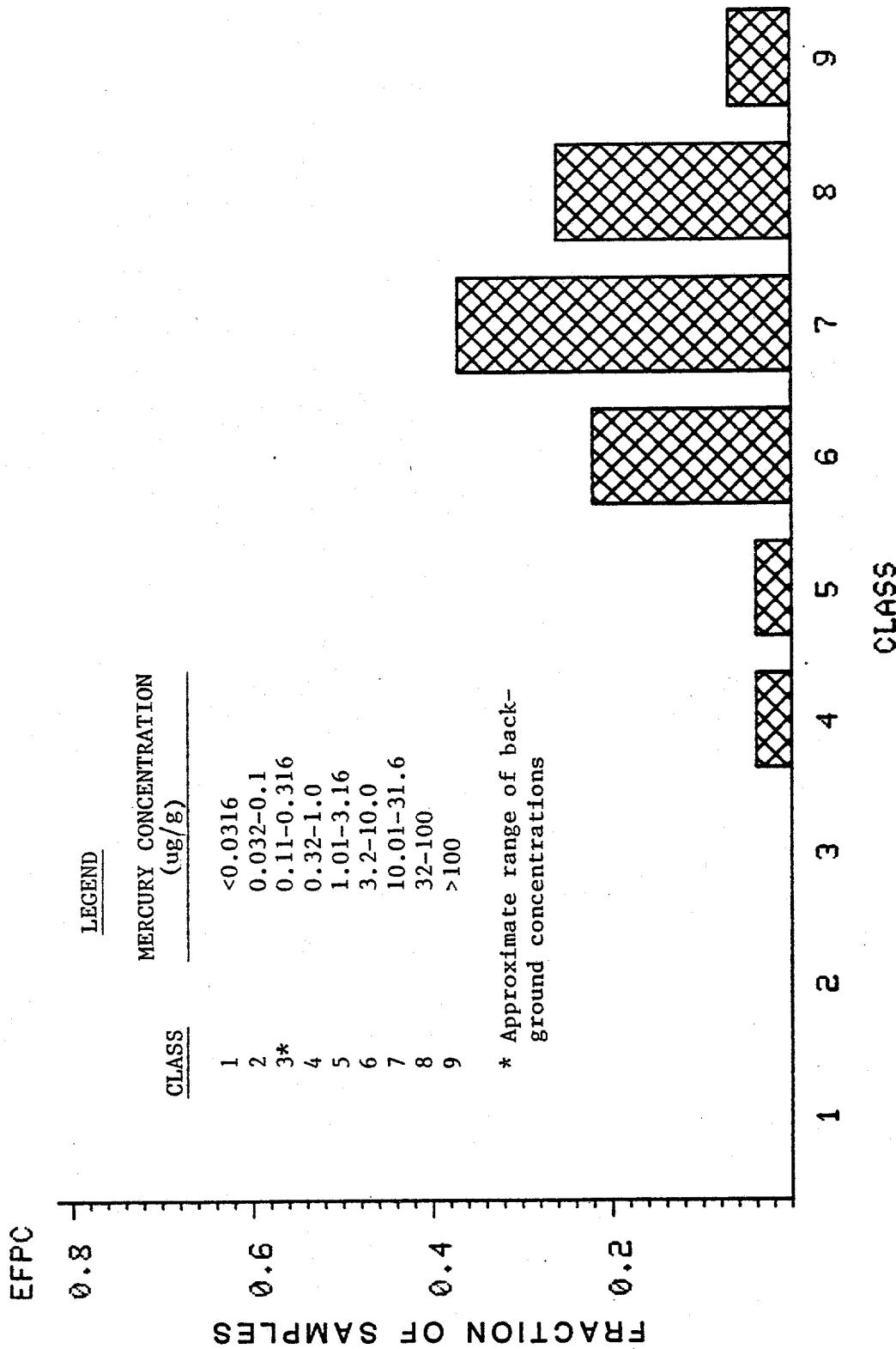


FIGURE 7

POPLAR CREEK SEDIMENT DATA

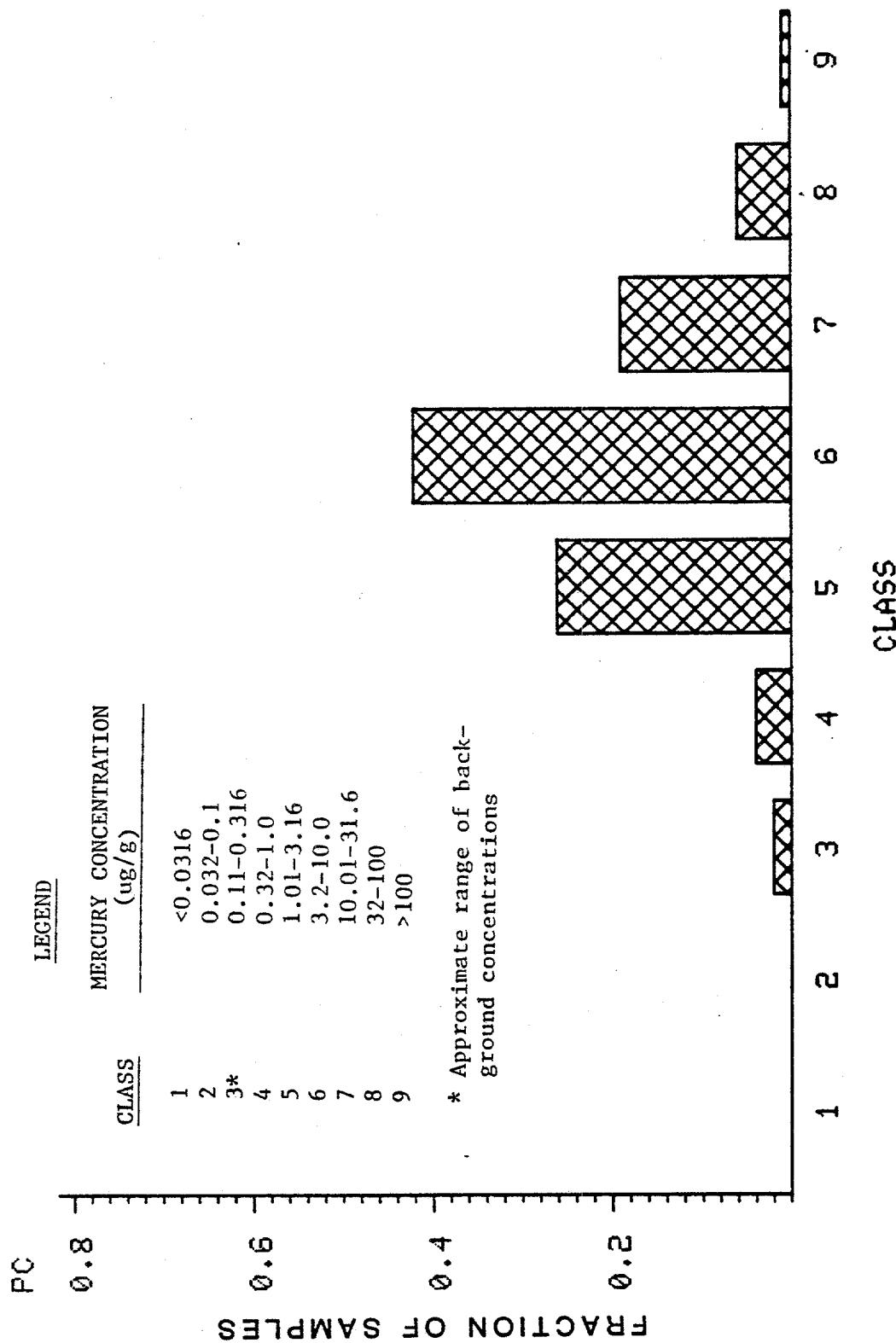


FIGURE 8

LOWER CLINCH RIVER SEDIMENT DATA

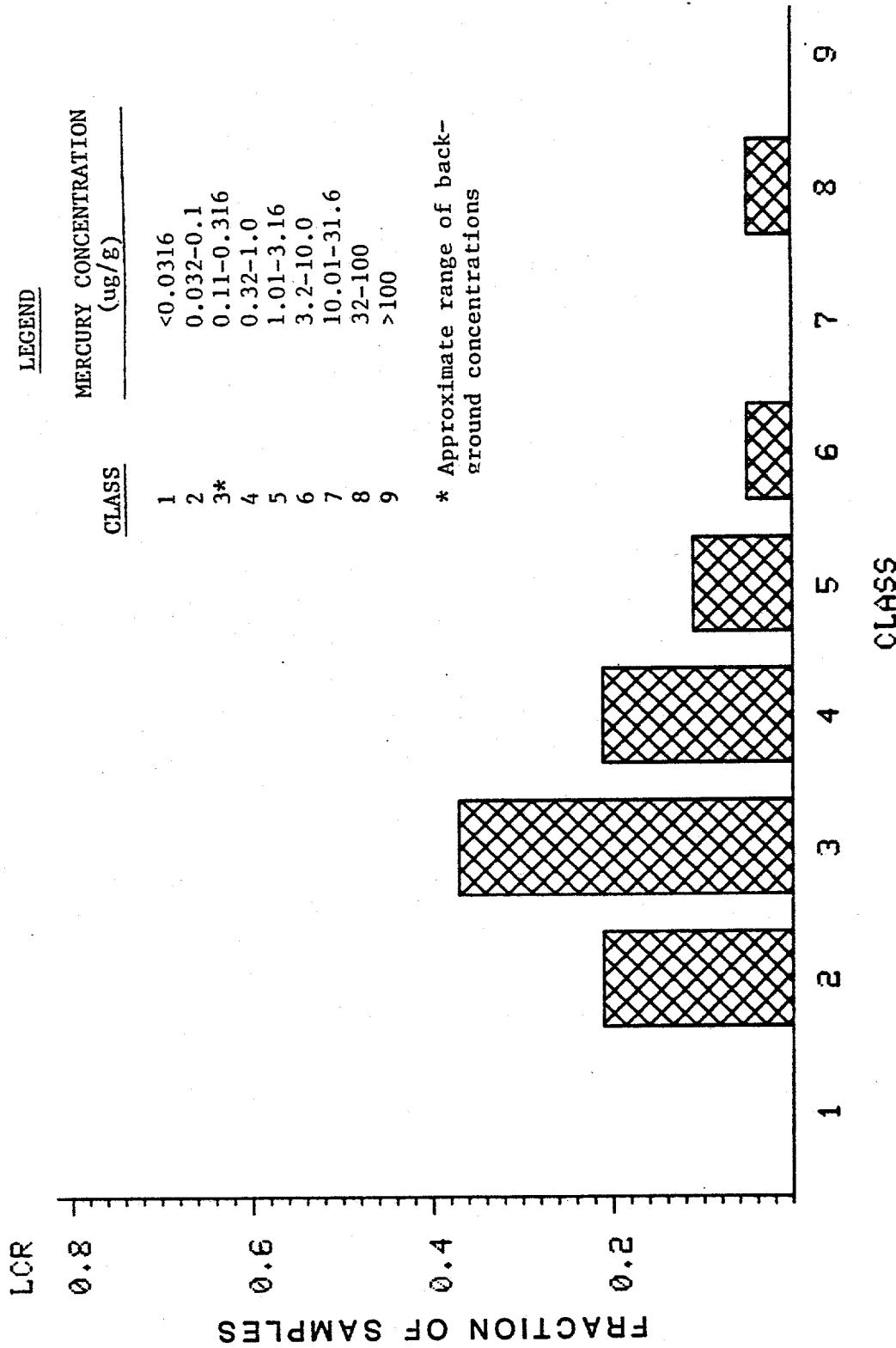


FIGURE 9

BEAR CREEK SEDIMENT DATA

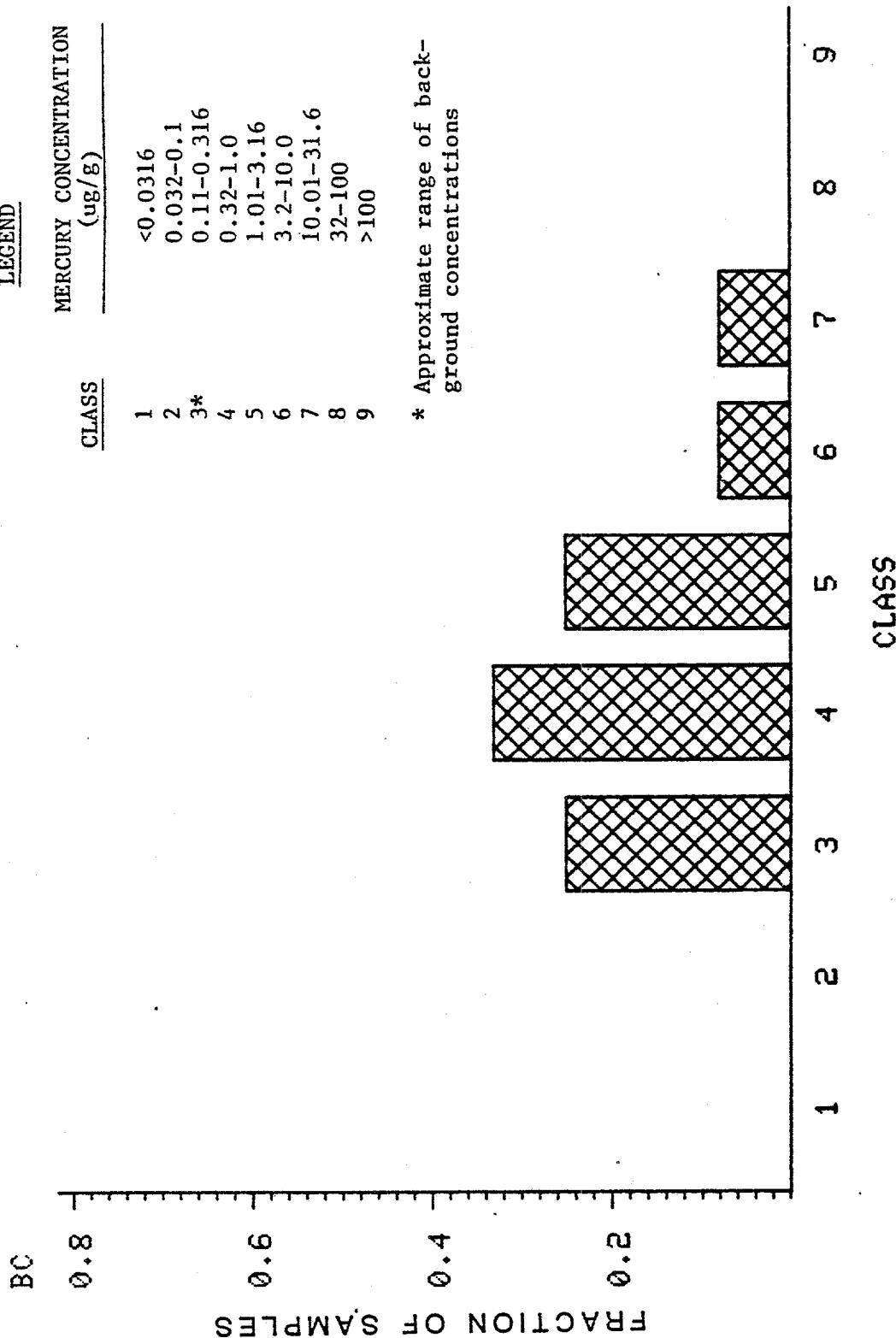


FIGURE 10

WHITE OAK CREEK SEDIMENT DATA

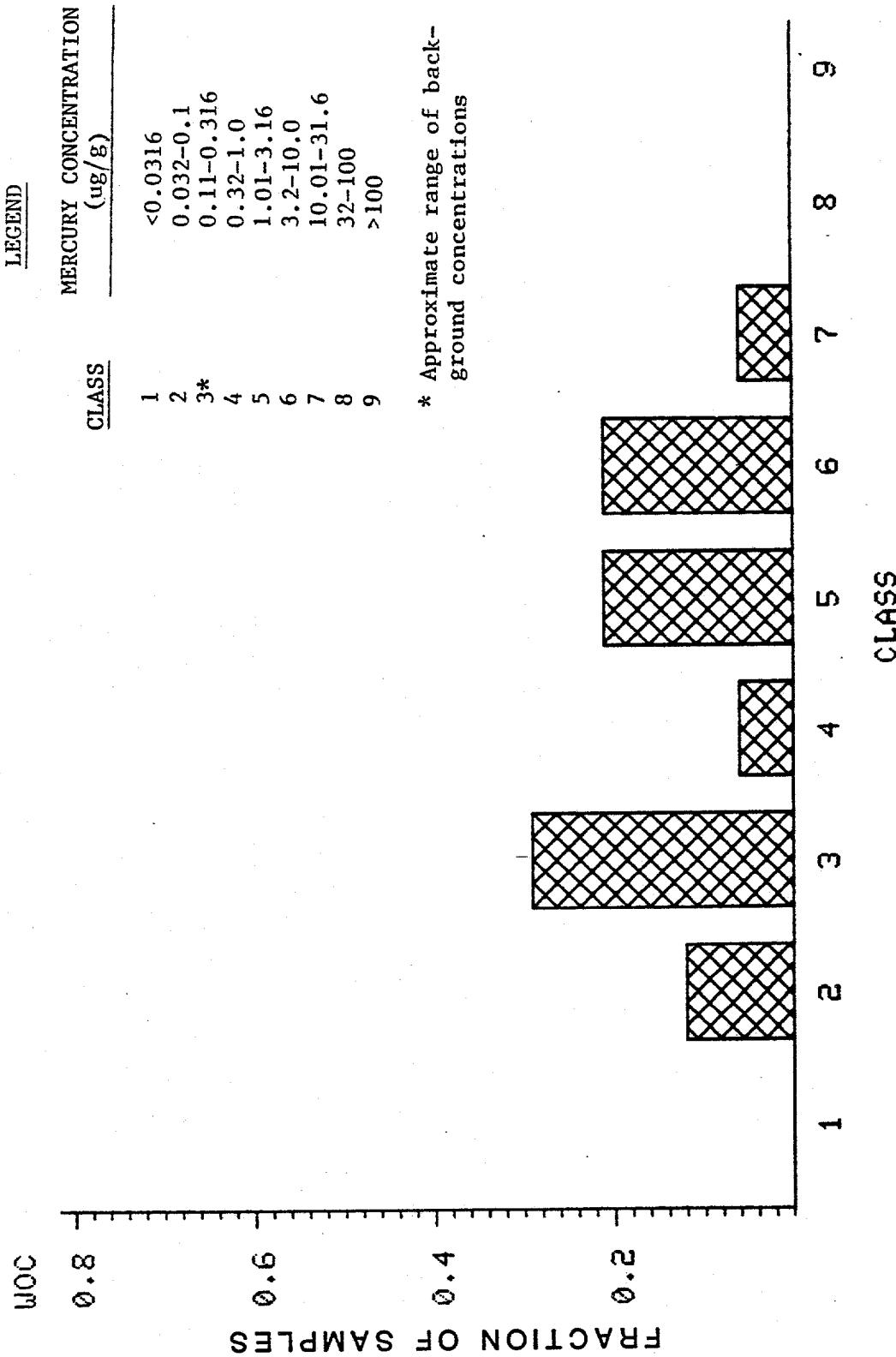


FIGURE 11

TENNESSEE RIVER SEDIMENT DATA

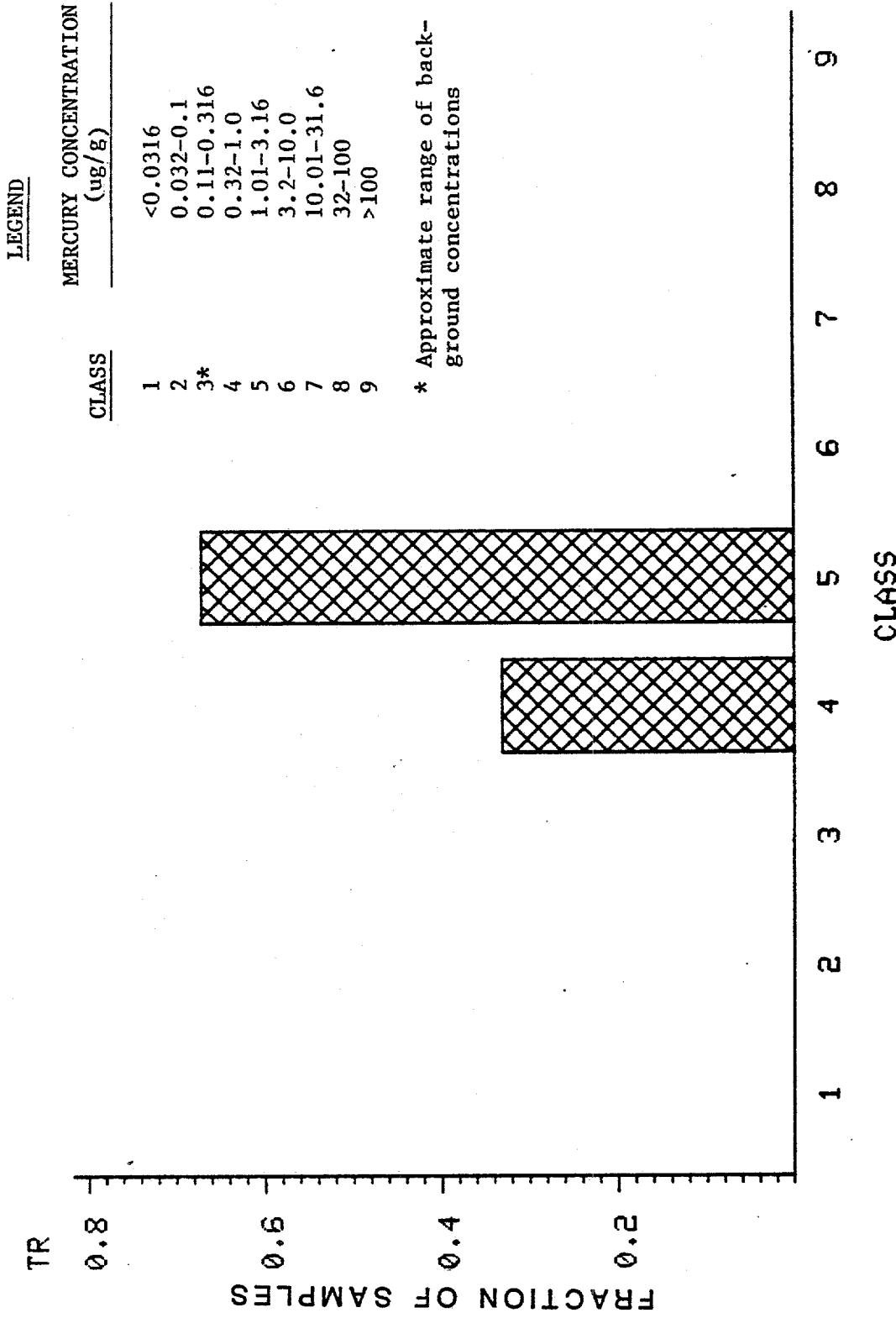


FIGURE 12

Mercury Conc. in Sediment

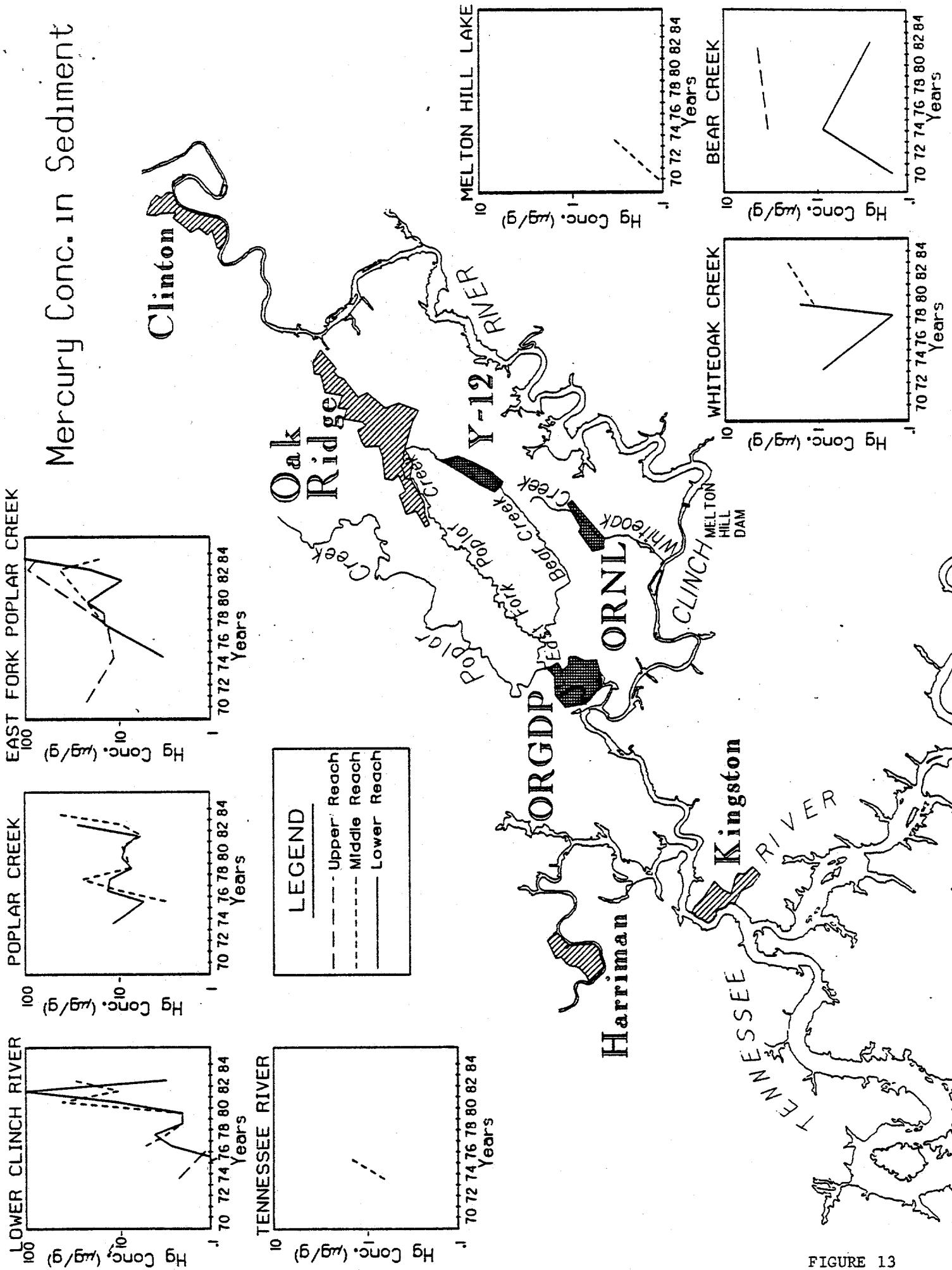


FIGURE 13

Mercury Conc. in Fish (All Species)

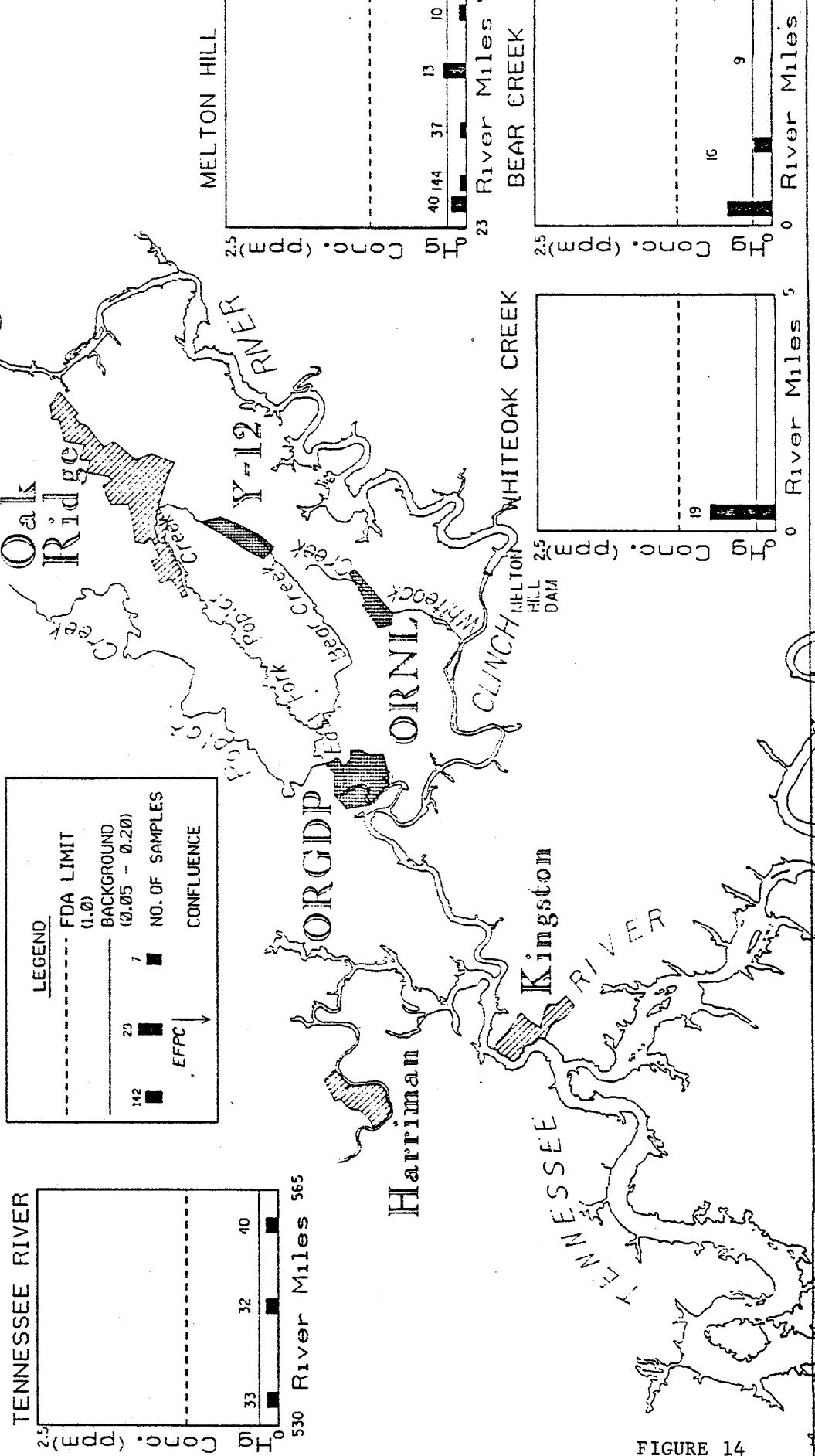
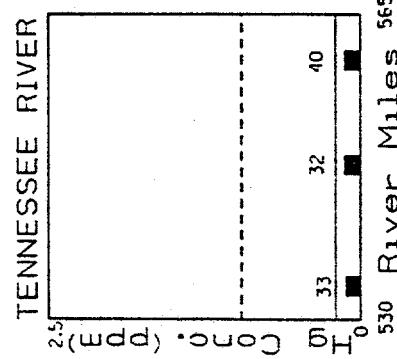
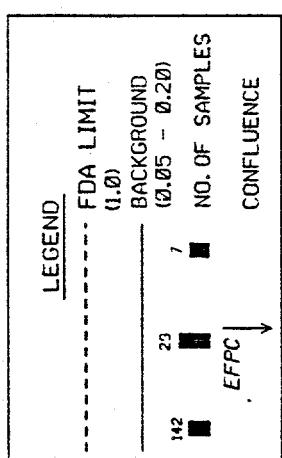
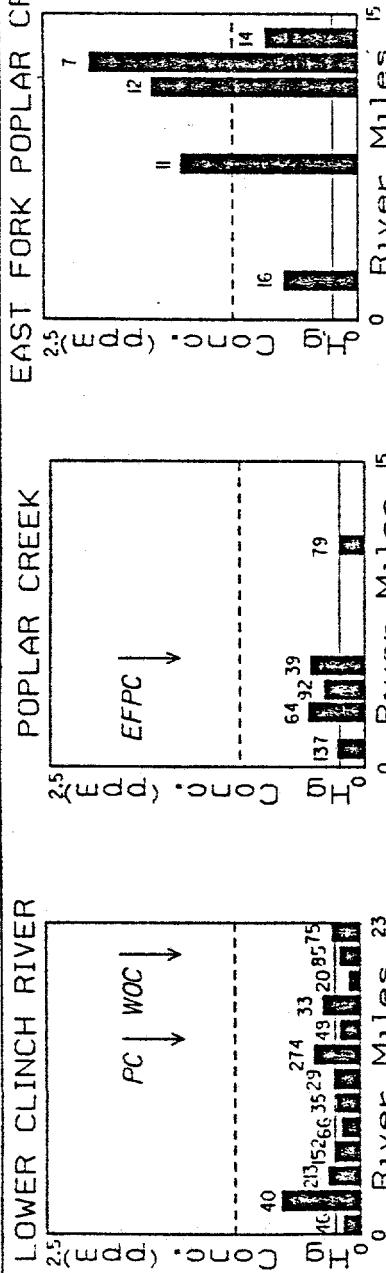
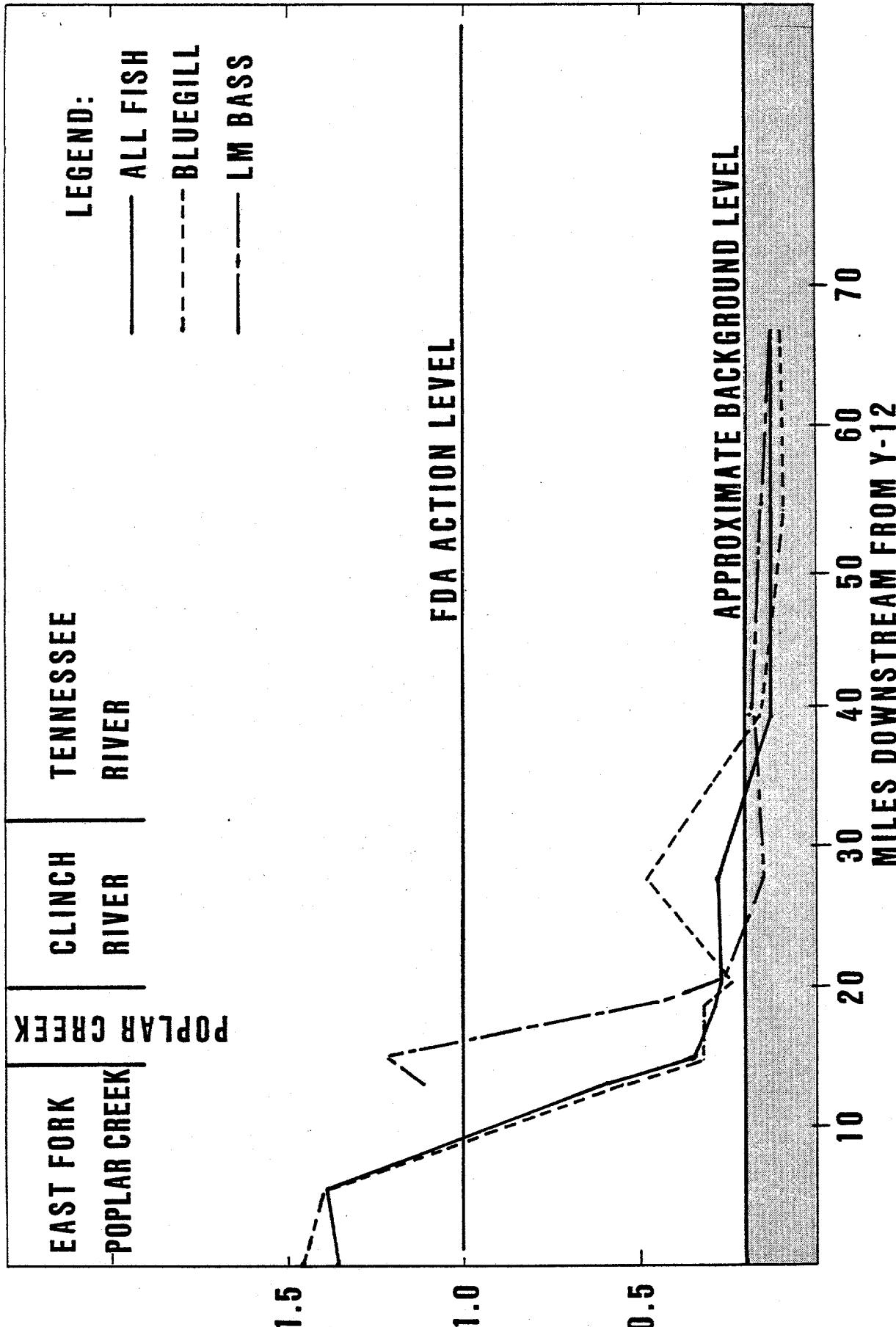


FIGURE 14



AVERAGE MERCURY CONCENTRATION IN FISH IN STREAM REACHES
DOWNSTREAM OF THE Y-12 PLANT (1970-1983)

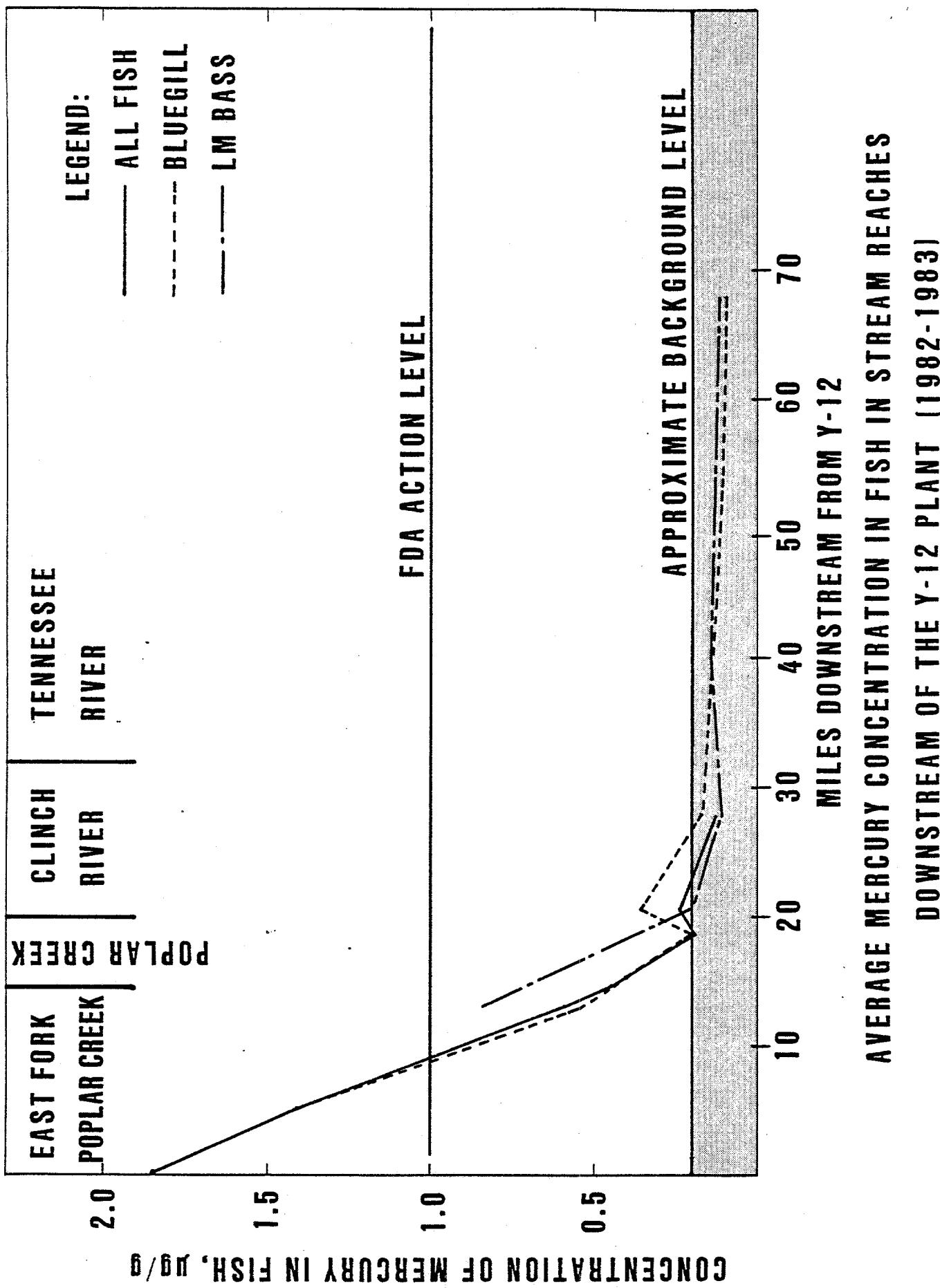


FIGURE 16

BLUEGILL ON UCR

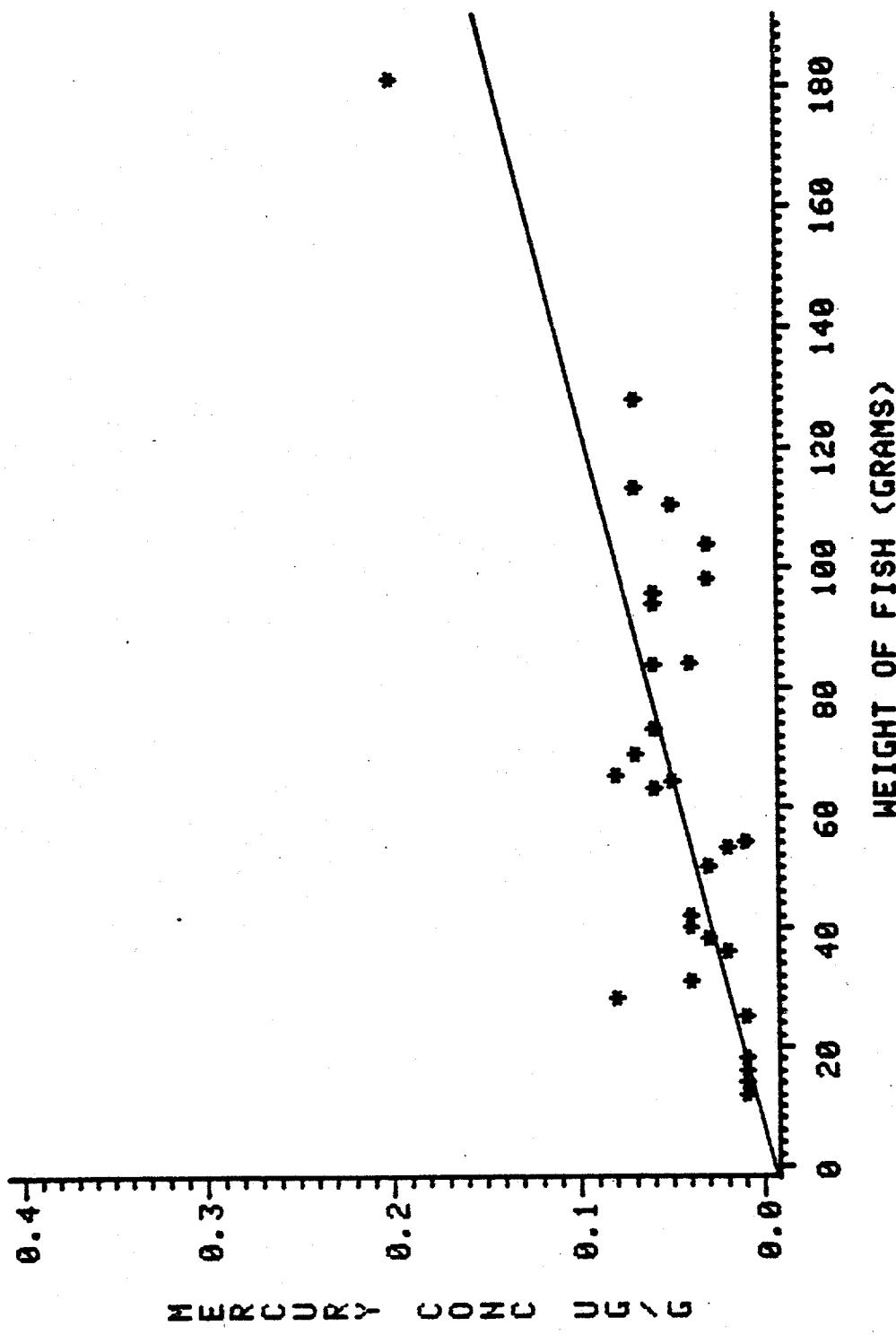


FIGURE 17

LM BASS ON UCR

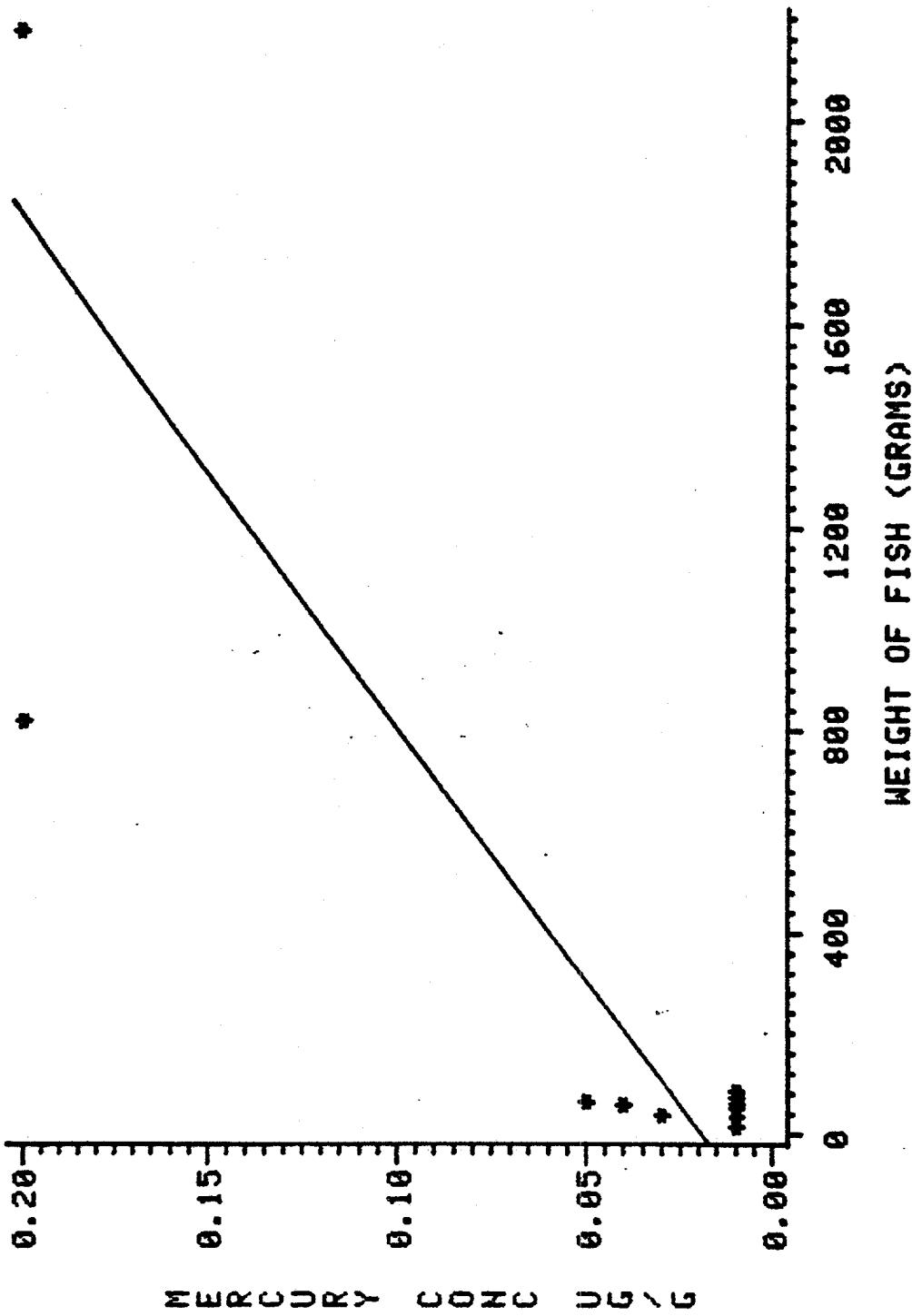


FIGURE 18

ALL FISH ON UCR

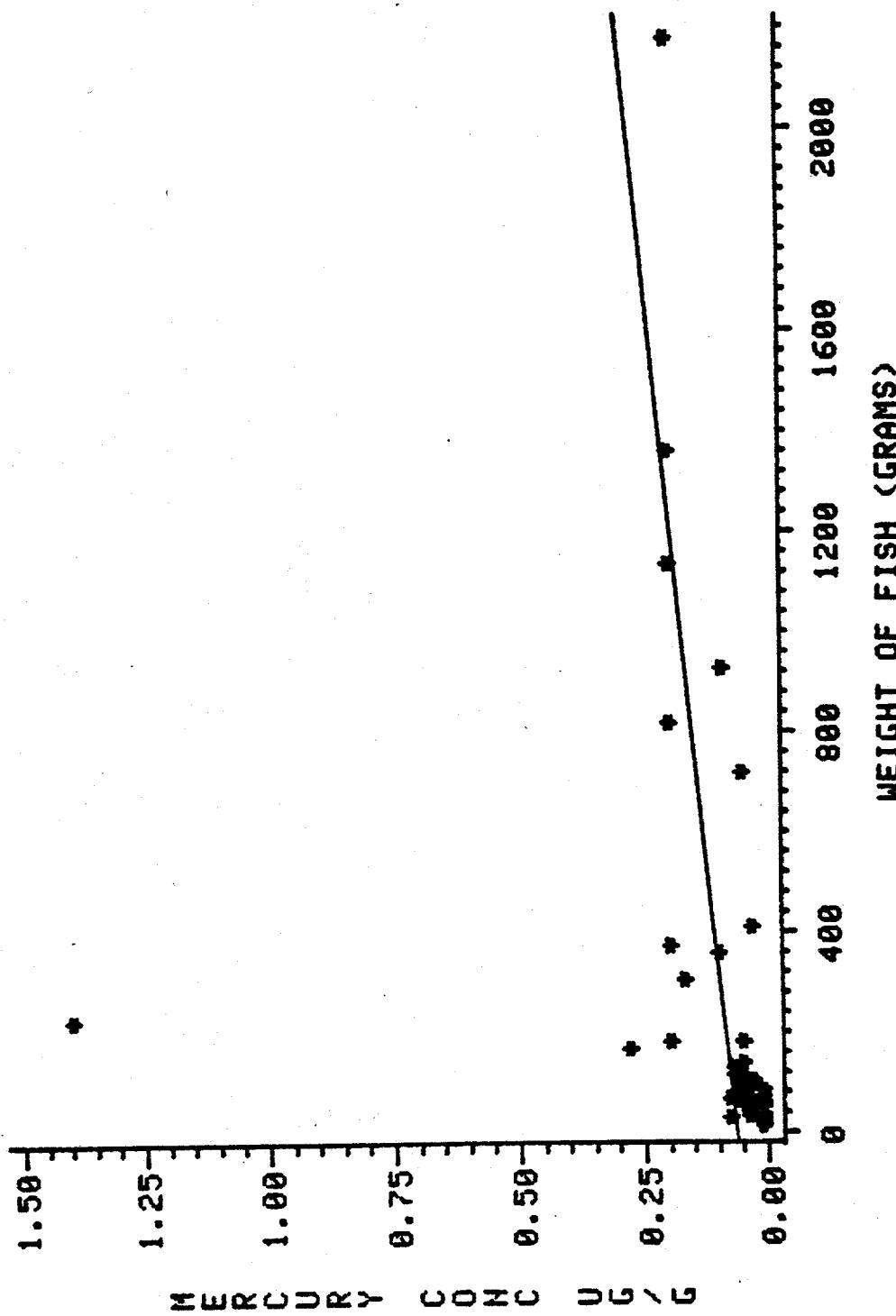


FIGURE 19

BLUEGILL ON EFPC MILES 14.1 - 14.3

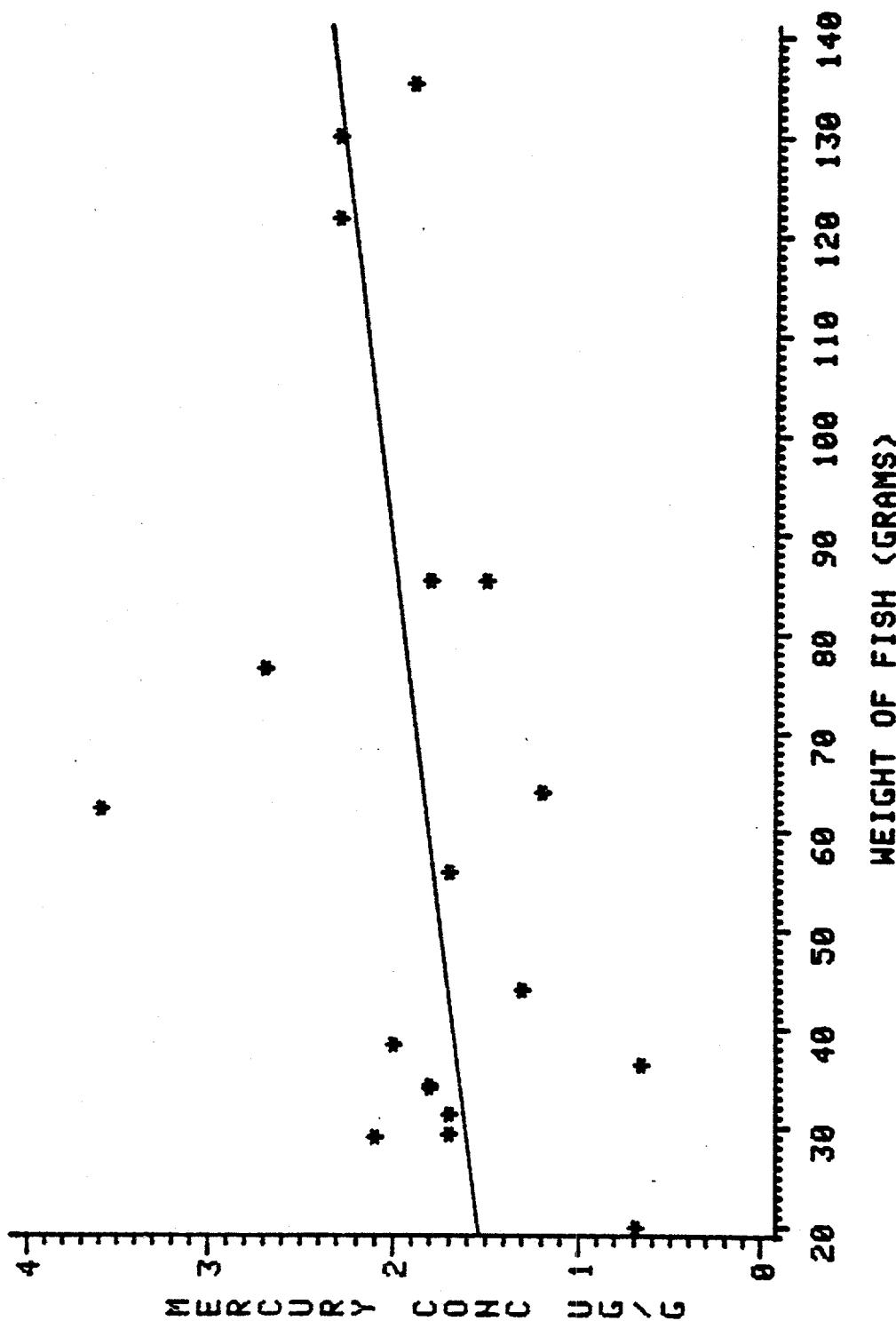


FIGURE 20

ALL FISH ON EFPC MILES 14.1 - 14.3

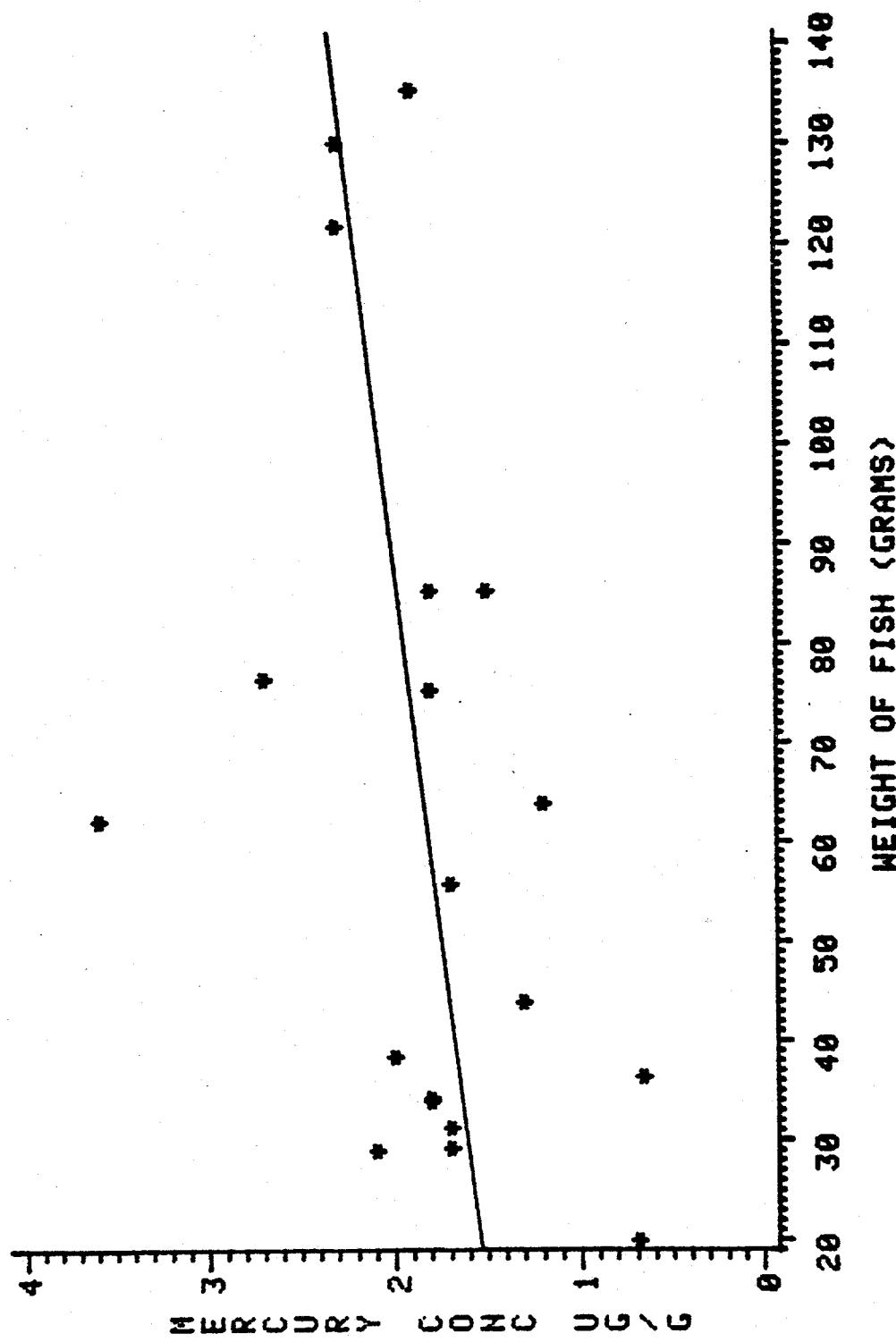


FIGURE 21

BLUEGILL ON PC MILES 2.5 - 5.5

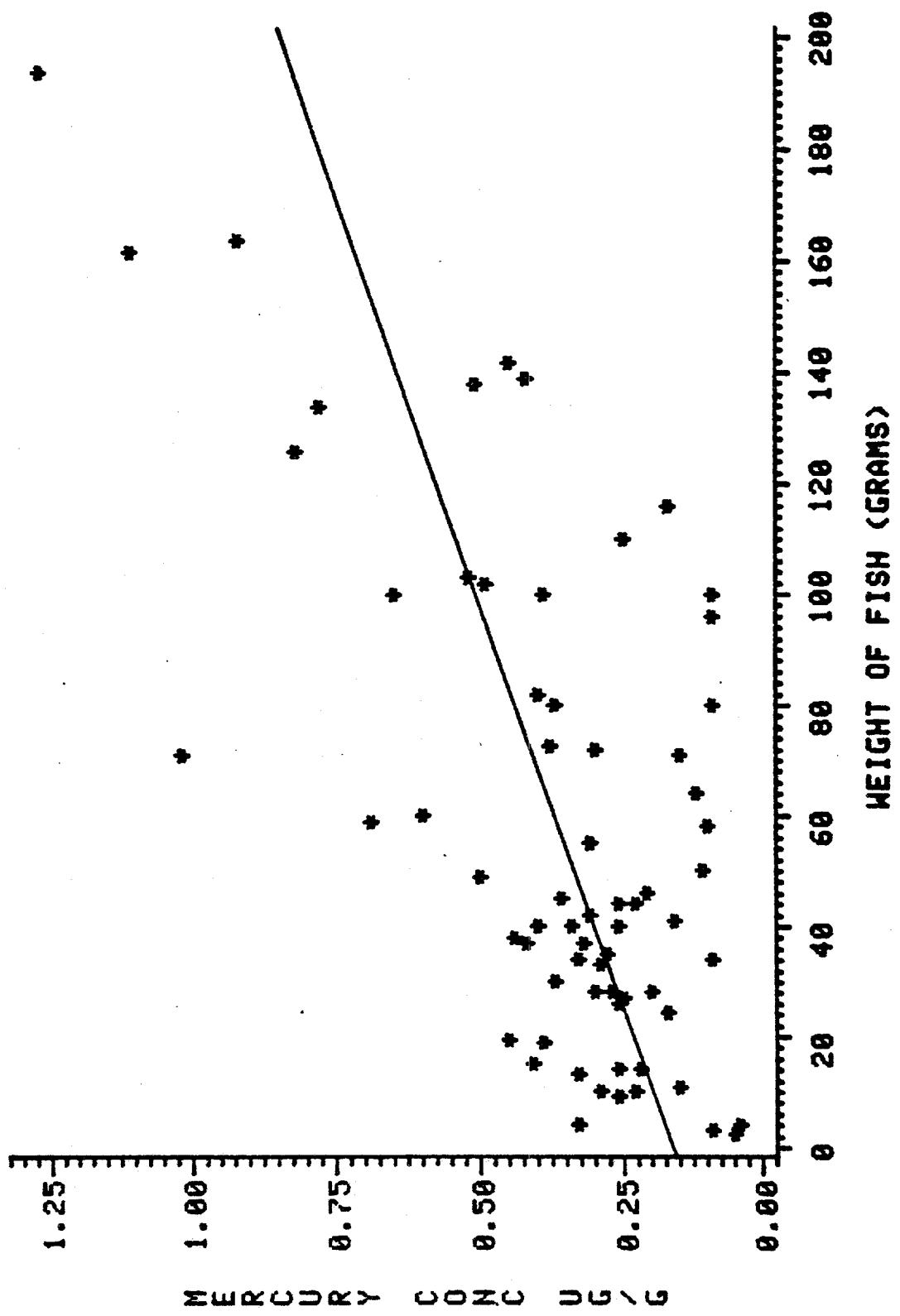


FIGURE 22

LM BASS ON PC MILES 2.5 - 5.5

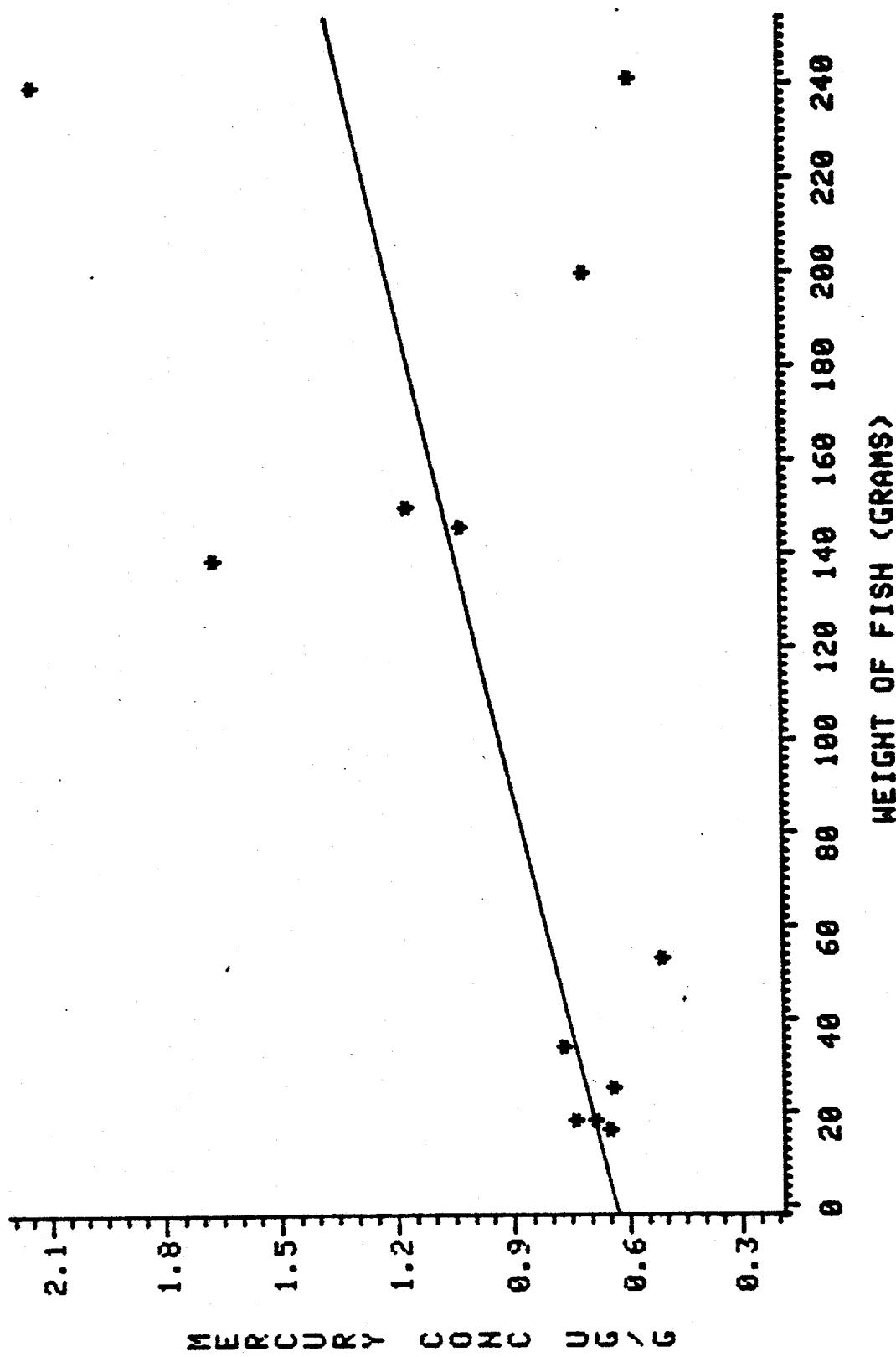


FIGURE 23

ALL FISH ON PC MILES 2.5 - 5.5

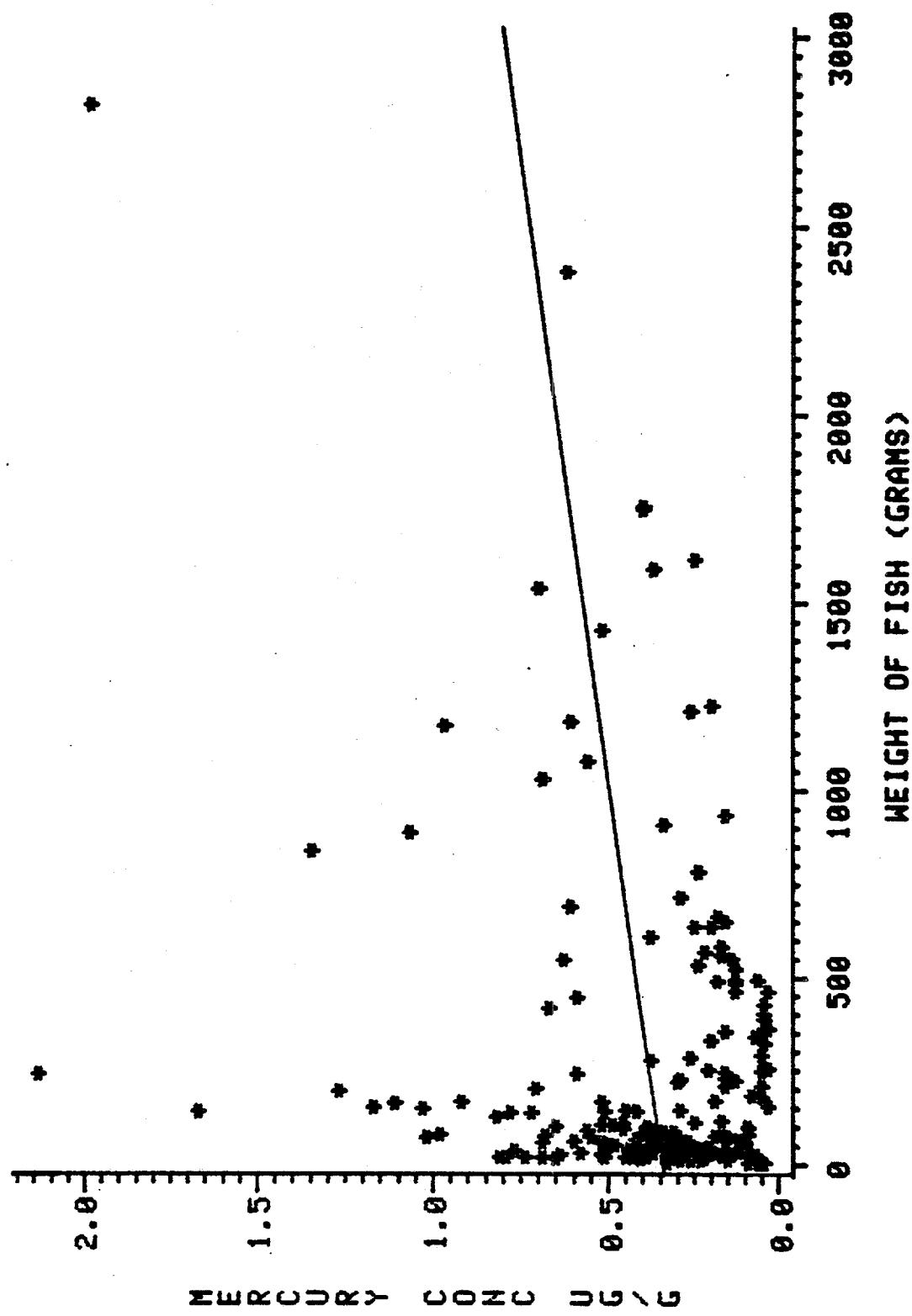


FIGURE 24

BLUEGILL ON LCR MILES 10.0 - 12.0

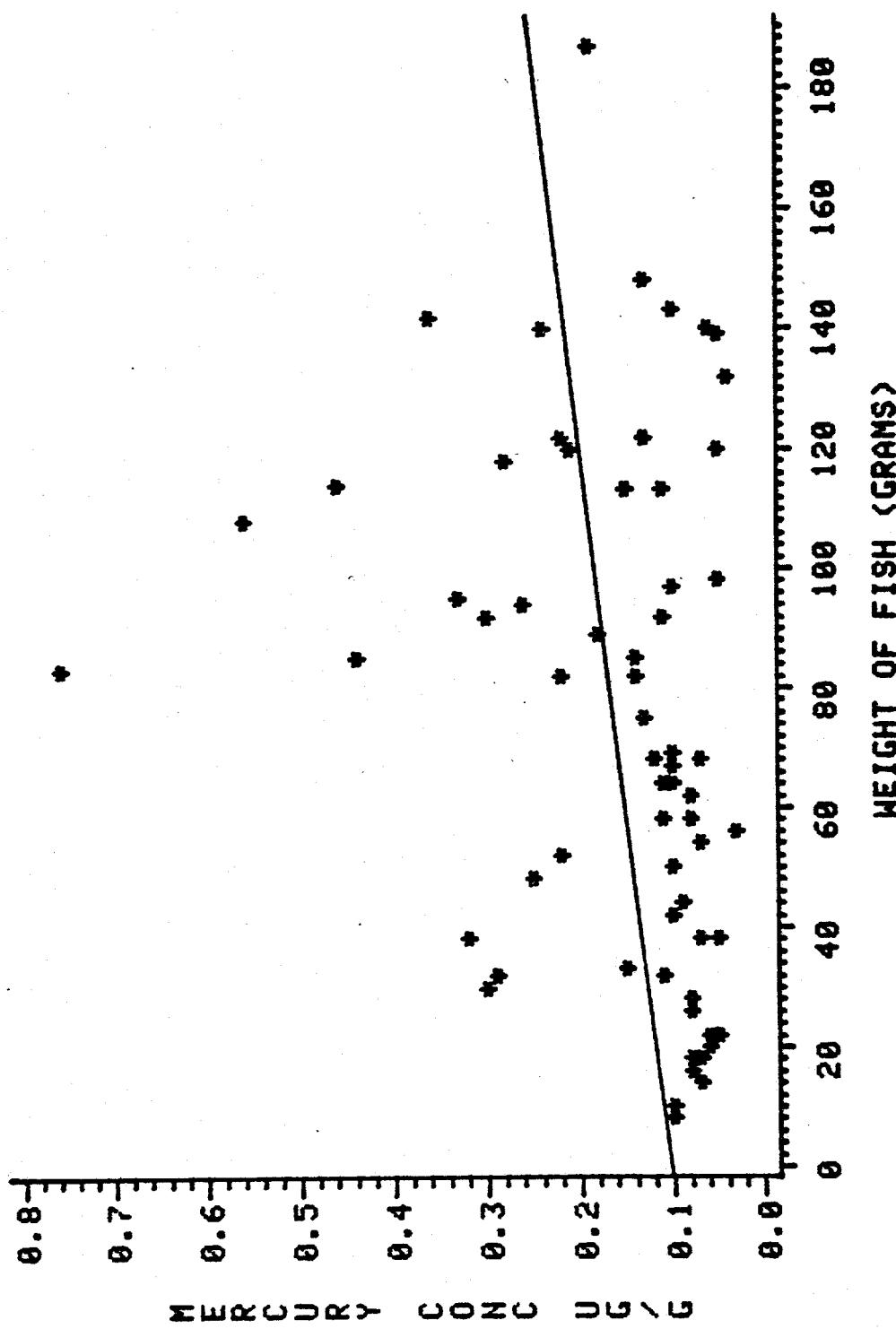


FIGURE 25

LM BASS ON LCR MILES 10.0 - 12.0

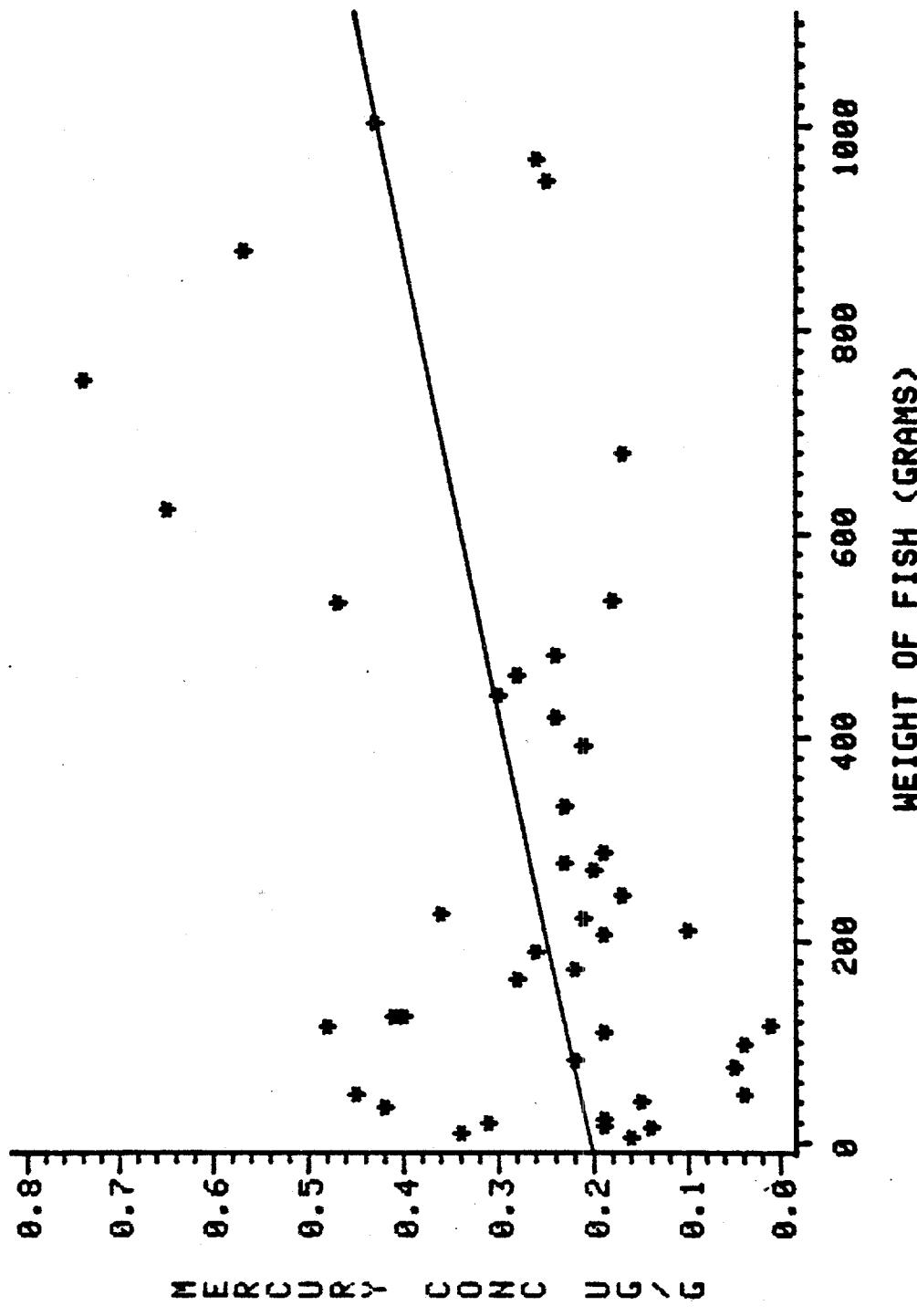


FIGURE 26

ALL FISH ON LCR MILES 10.0 - 12.0

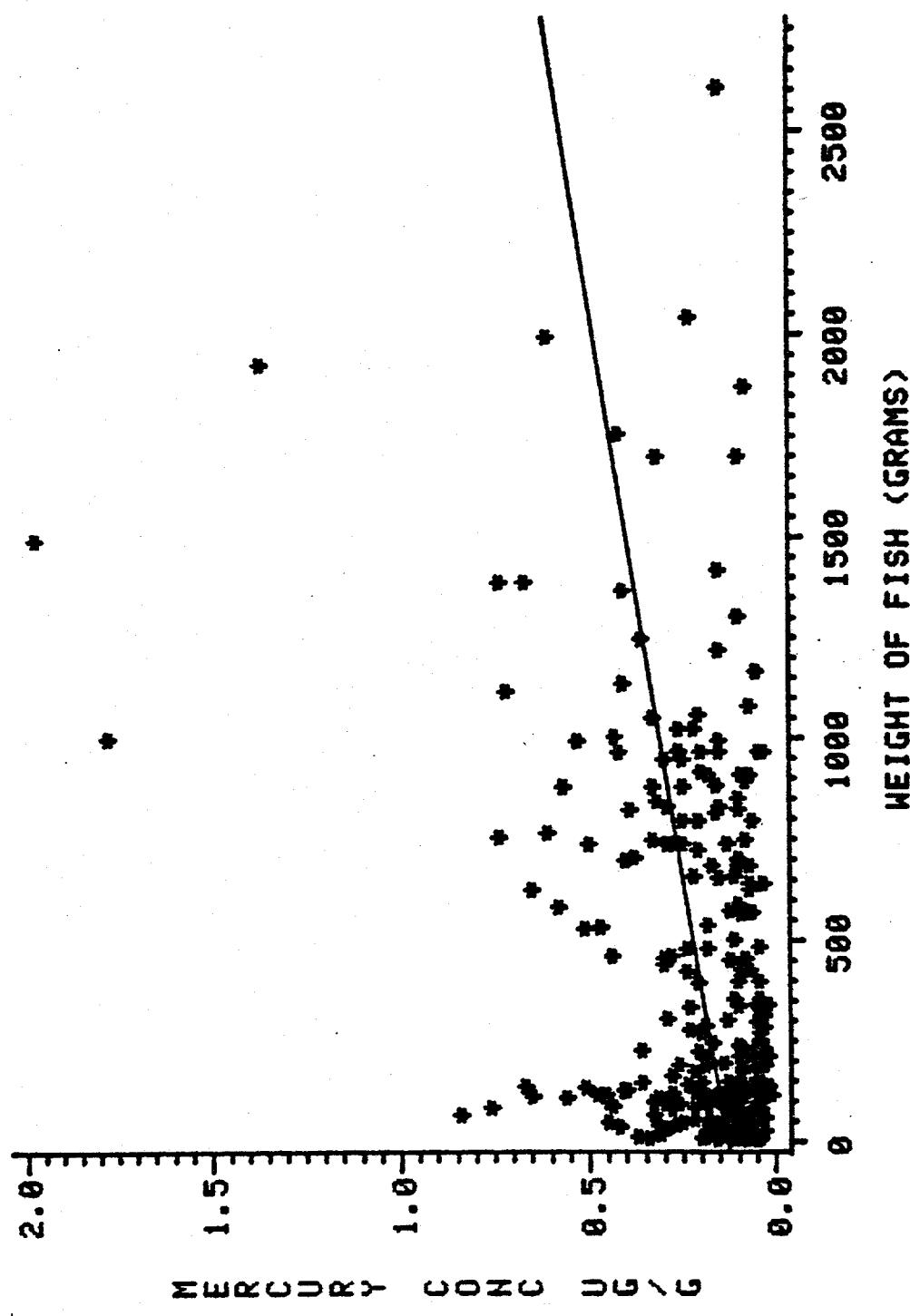
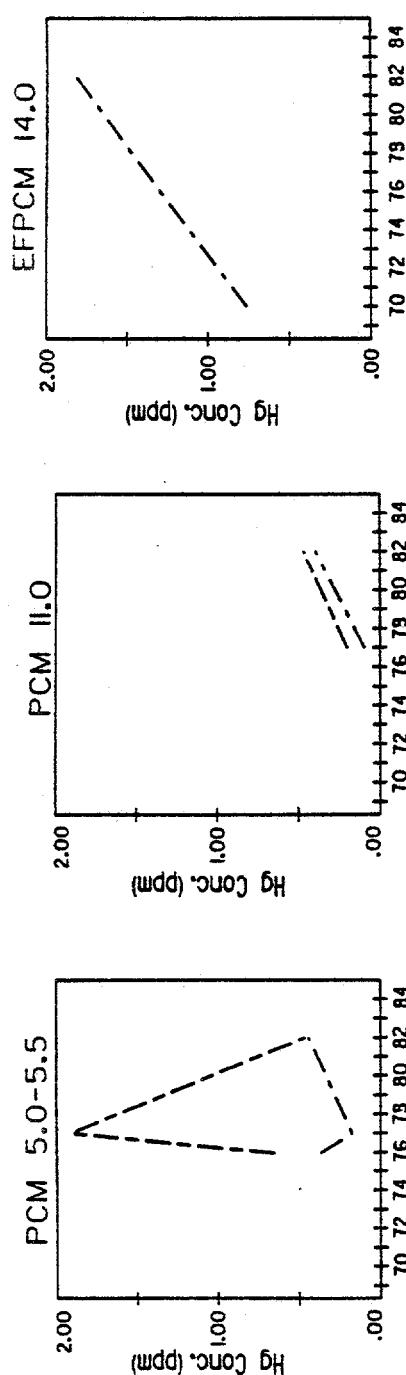


FIGURE 27

Mercury Conc. in Fish (Selected Species)



LEGEND

- BASS
- - - BLUEGILL
- - - - - CARP
- - - - - WHITEBASS
- - - - - LARGEMOUTH BASS
- - - - - CRAPPIE

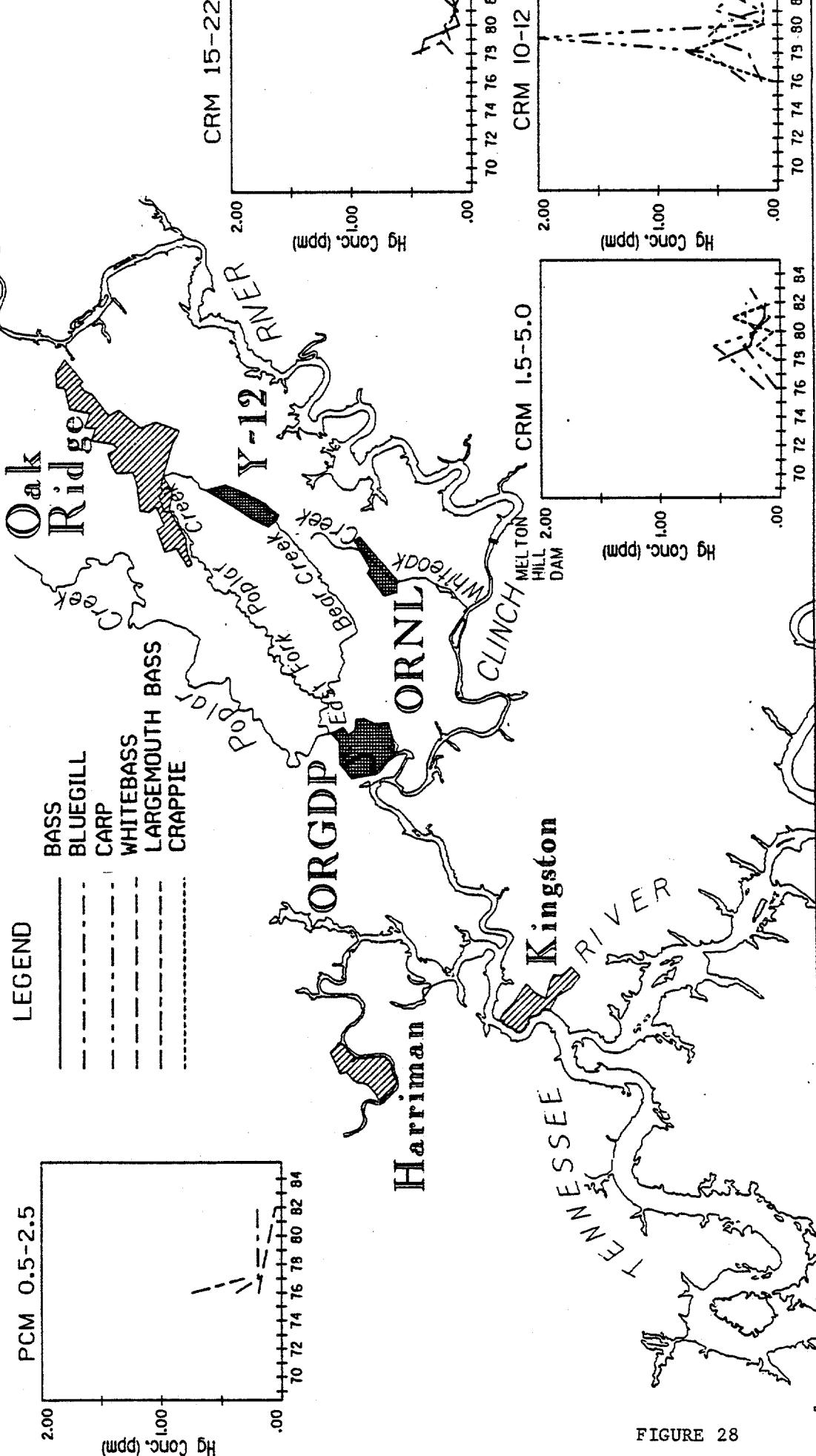


FIGURE 28

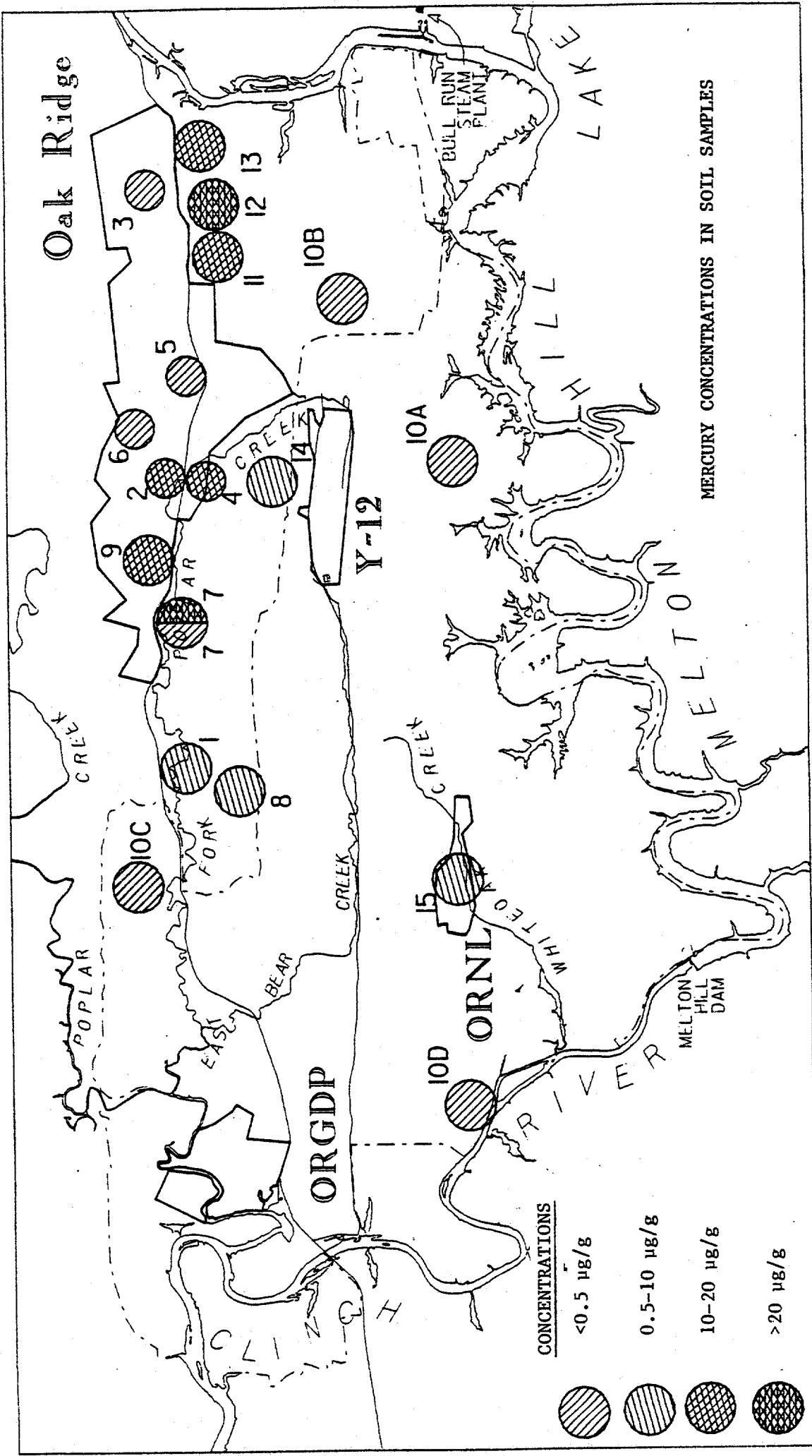


FIGURE 29

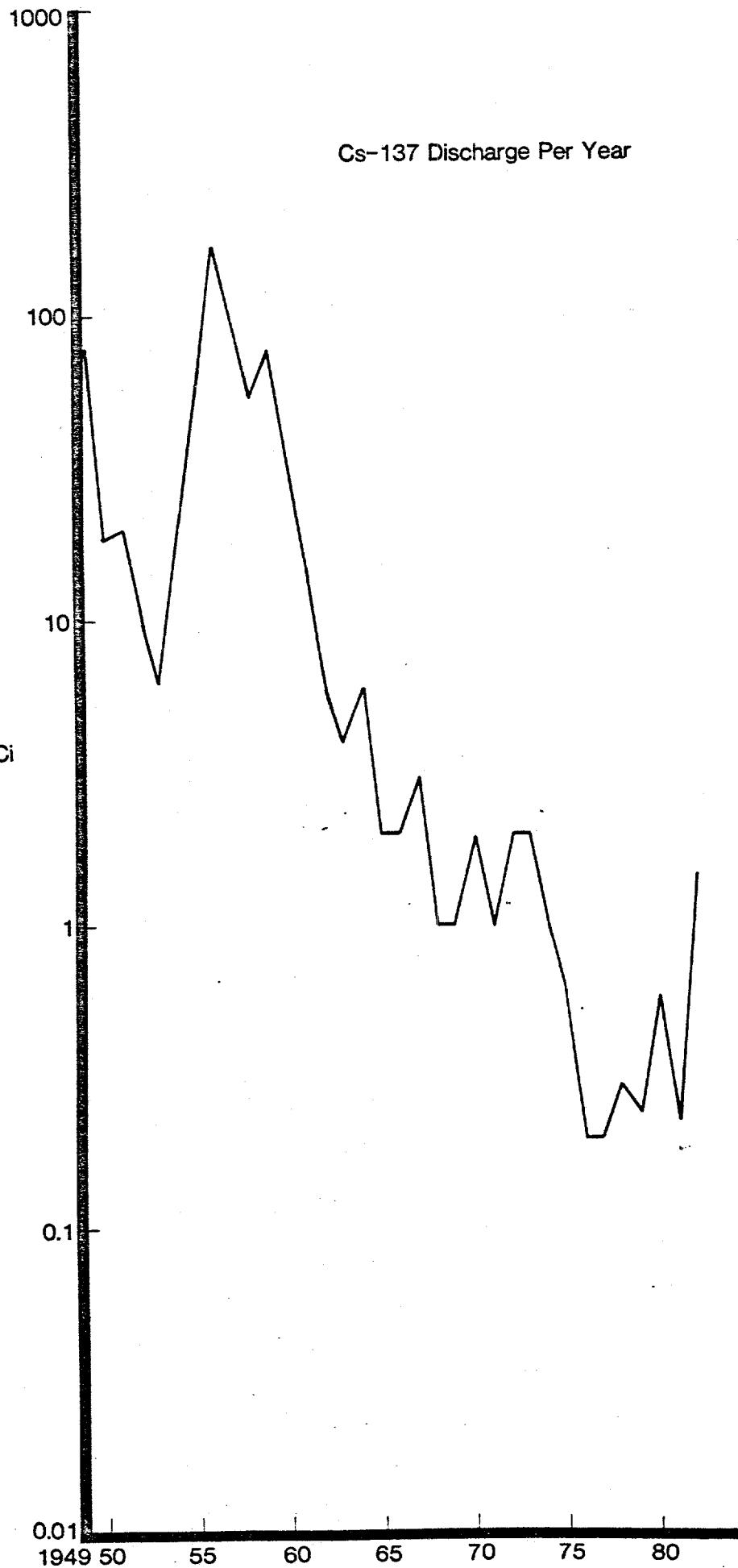
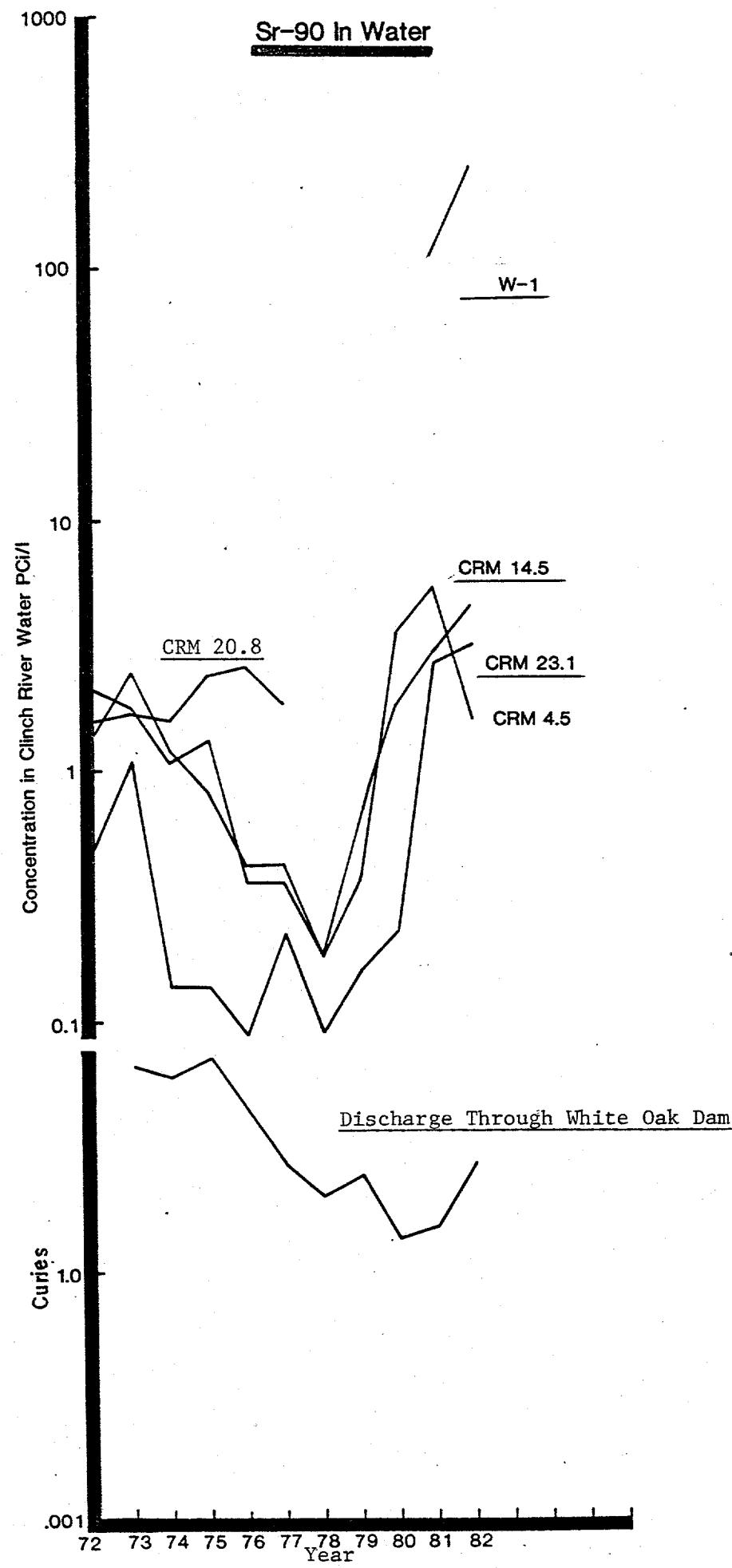


FIGURE 30



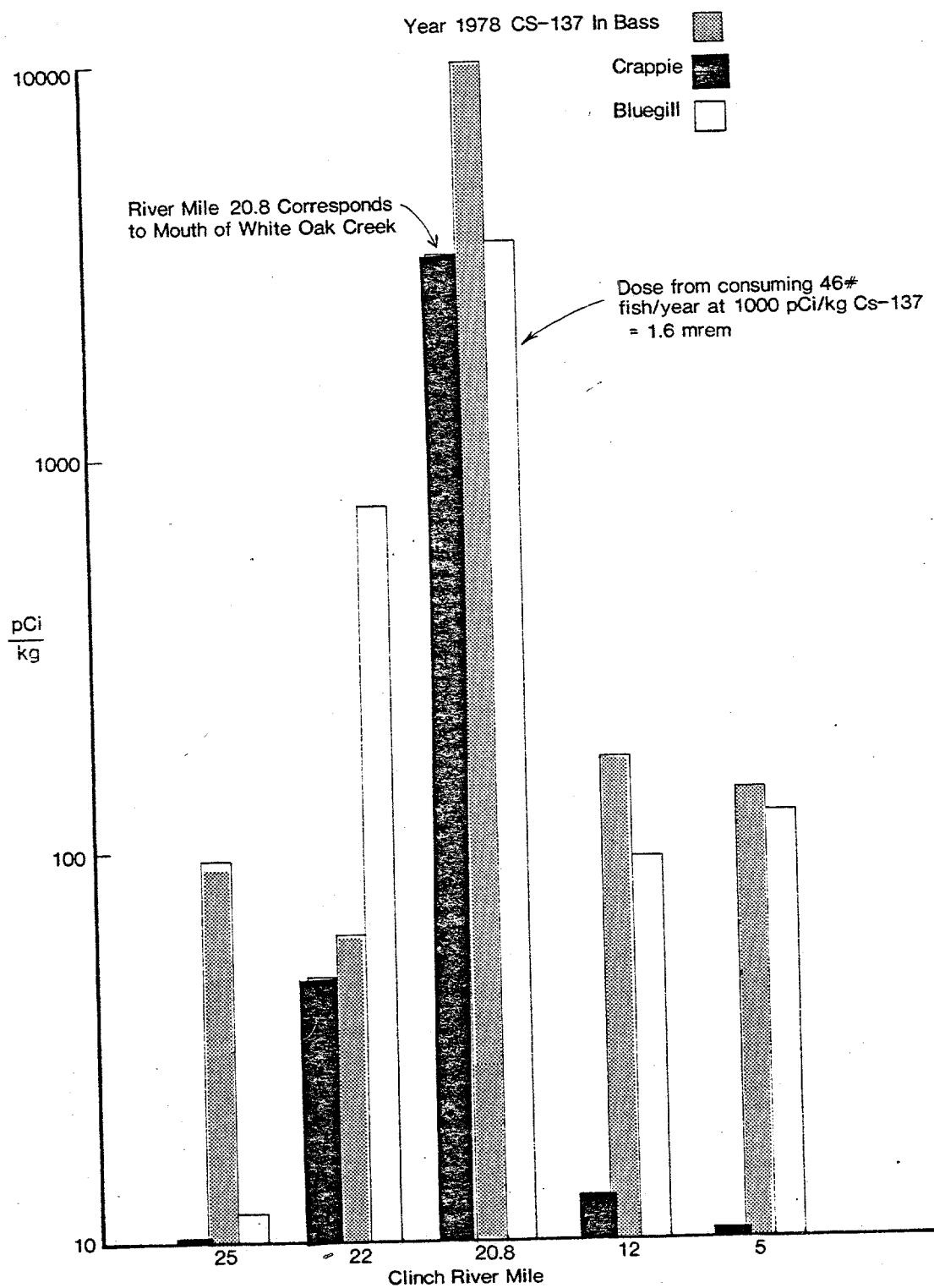


FIGURE 32

Section at CRM 7.5 Showing Penetration, Recovery, and Gross Gamma Radioactivity Variation with Depth for 1962 Bottom Sediment Core Samples (Vertical Exaggeration 10:1)

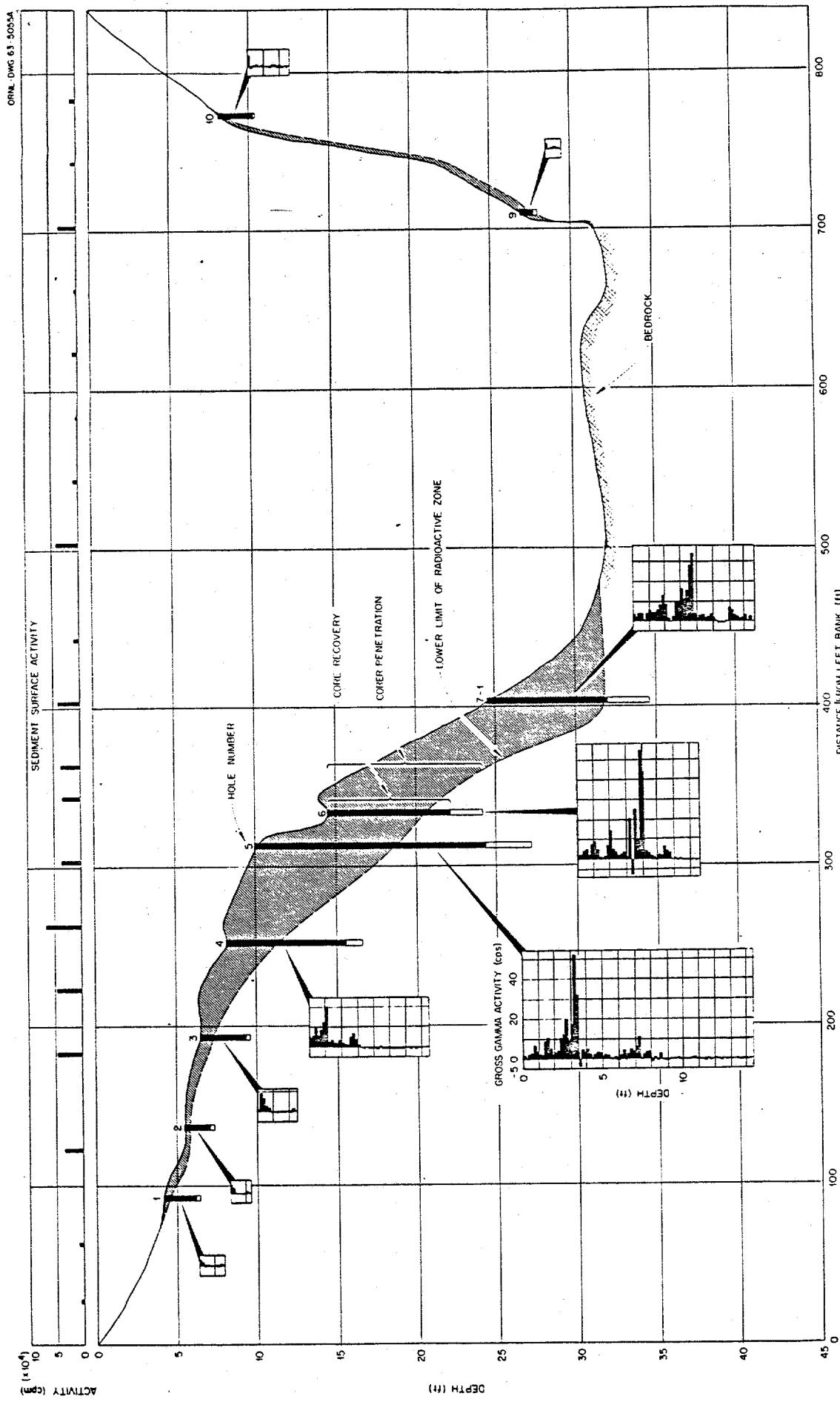
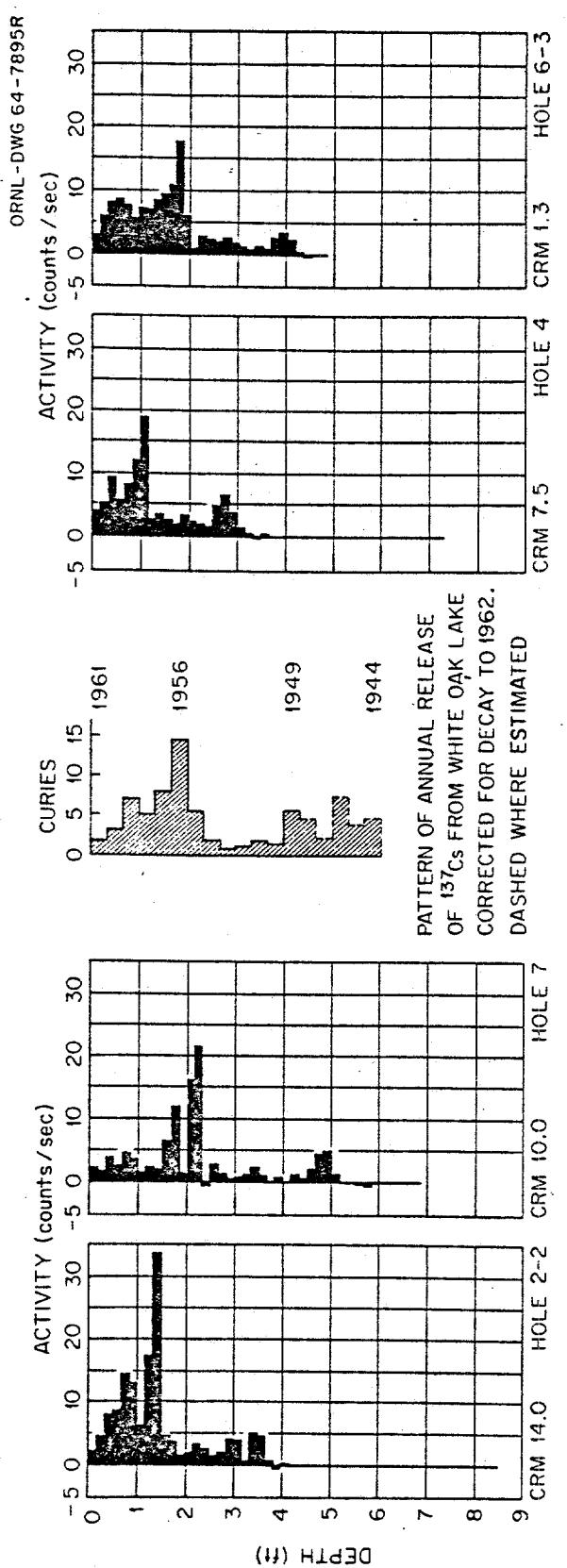


FIGURE 33



Comparison of Patterns of Variation with Depth of Gross Gamma Radioactivity
in Four Bottom Sediment Cores to Variations in Annual Releases of ^{137}Cs to
Clinch River

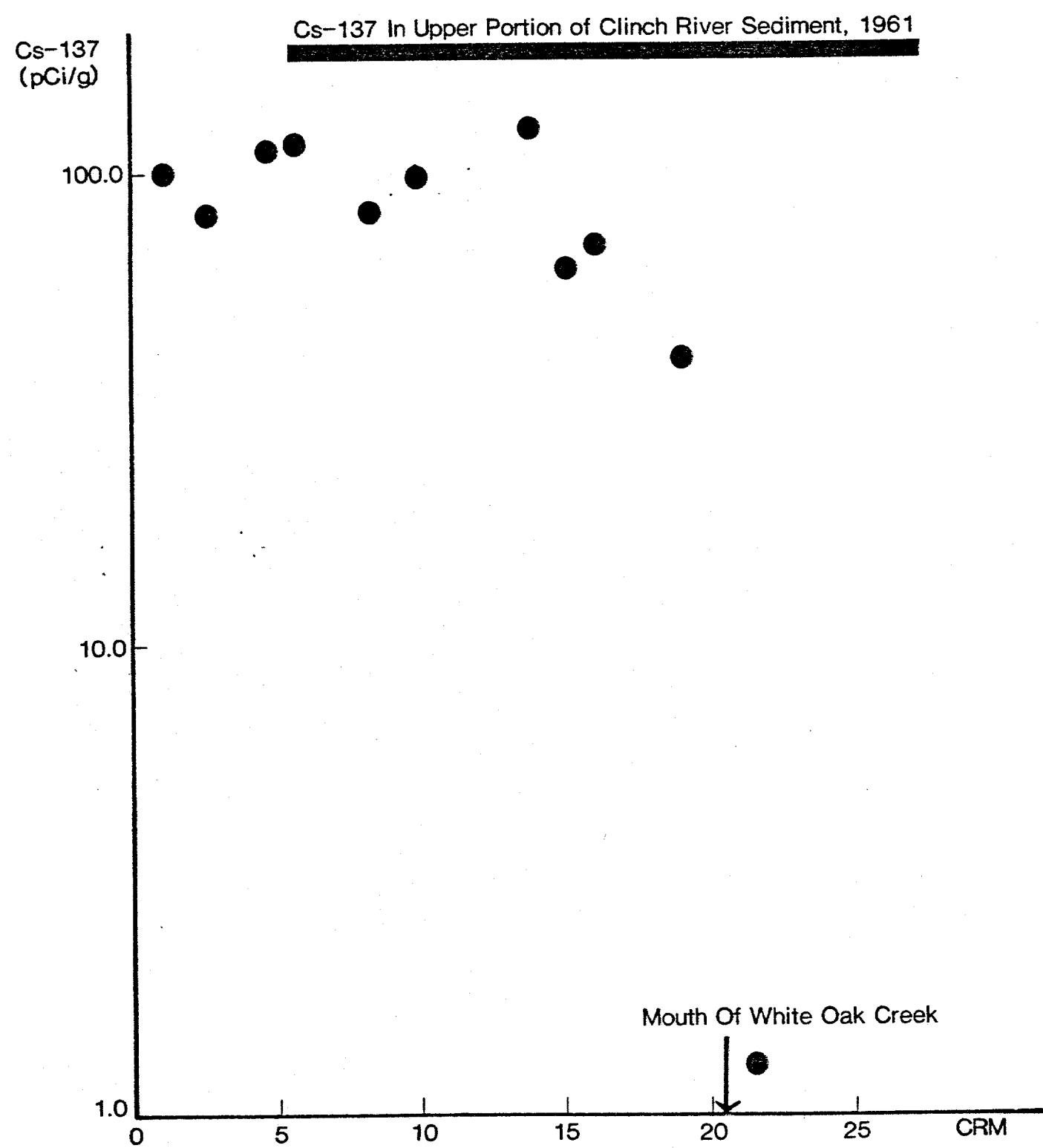


FIGURE 35

100

Cs-137 In Upper Portion Of Tennessee River Sediment, 1961

Cs-137
(pCi/g)

10

1.0

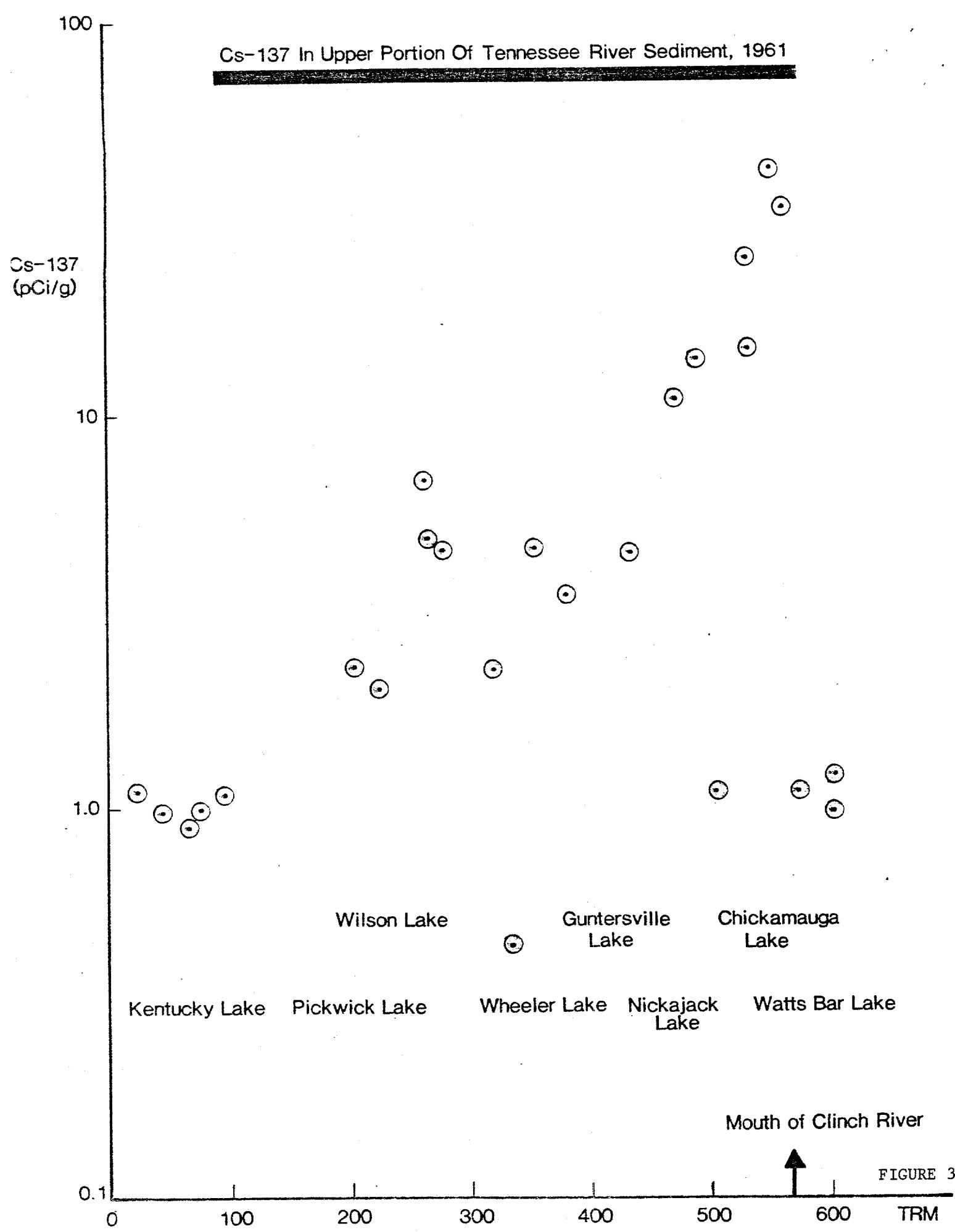
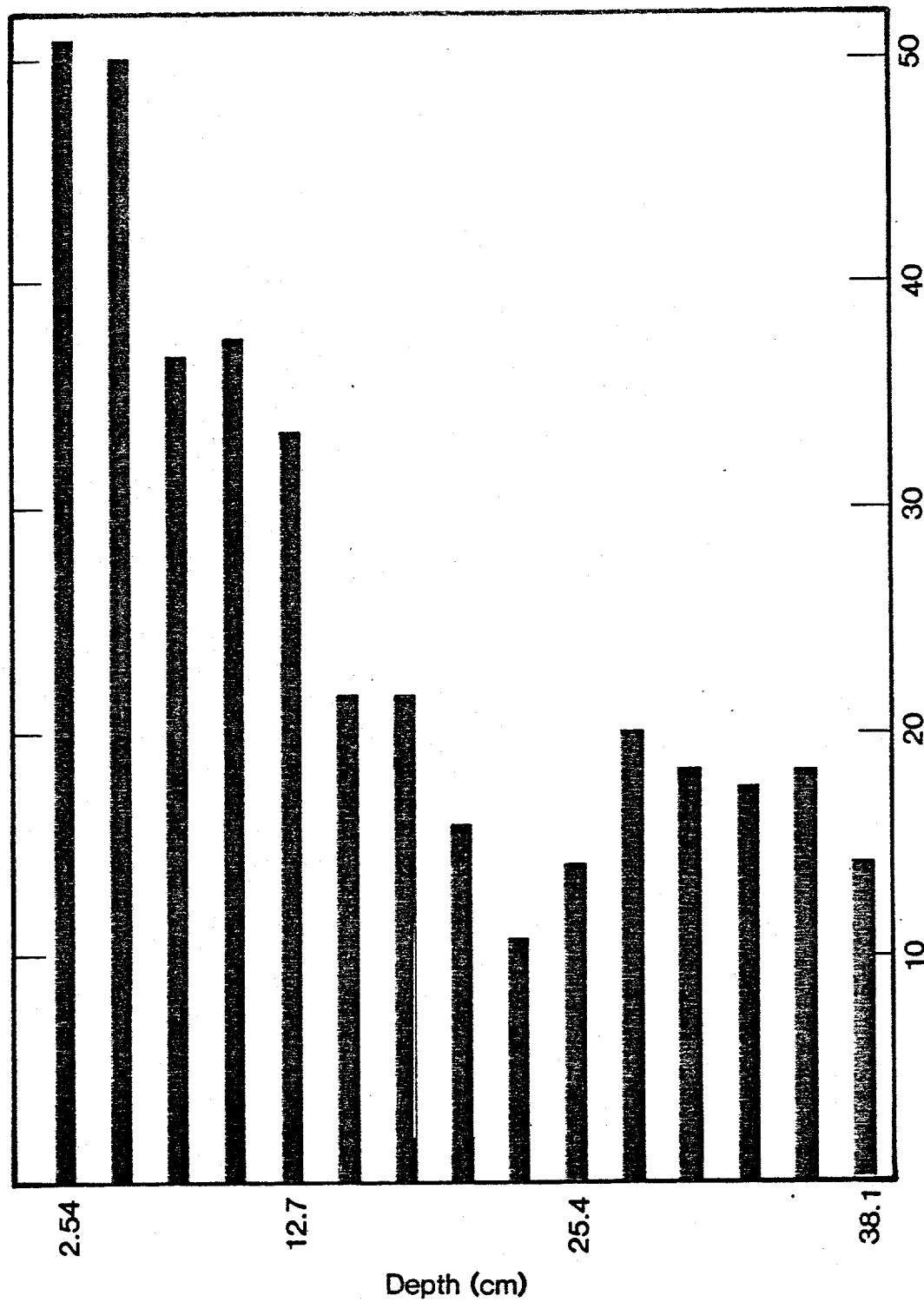


FIGURE 36

Cesium-137 Content (Bq/g) In White Oak Creek Sediment, 1978 Sampling Program



Appendix II - Tables

<u>Table No.</u>	<u>Title</u>
1	Sources of Data
2	Summary of Available Data
3	Parameters Examined
4	Number of Samples
5	Comparison of Mean Values for Various Chemical Parameters in Water
6	Comparison of Mean Values for Various Chemical Parameters in Sediment
7	Comparison of Mean Values for Various Chemical Parameters in Fish in Poplar Creek
8	Comparison of Mean Values for Various Chemical Parameters in Fish in the Lower Clinch River Below Melton Hill Dam
9	Criteria and Selected Data for Chemical Parameters in Water
10	Criteria and Selected Data for Chemical Parameters in Sediment and Soil
11	Criteria and Selected Data for Chemical Parameters in Fish
12	Summary of Conclusions Regarding Concentrations in Fish, Sediment, and Water
13	Comparison of Average Concentrations for Selected Parameters in Sediment
14	Comparison of Average Concentrations for Selected Parameters in Fish from Poplar Creek
15	Mercury Concentrations in Sediments of the Upper Tennessee River
16	Mercury Analysis of Soils in the Oak Ridge Area

SOURCES OF DATA

OAK RIDGE OPERATIONS

OAK RIDGE NATIONAL LABORATORY
ENVIRONMENTAL PROTECTION AGENCY

U. S. GEOLOGICAL SURVEY

STATE OF TENNESSEE

TENNESSEE VALLEY AUTHORITY

SUMMARY OF AVAILABLE DATA

1. DOE data submitted to TVA by letter of June 14, 1983 from J. F. Wing (see attached list).
2. State of Tennessee data for 1977-78 fish from lower Clinch River submitted to TVA in July 13, 1983 letter from David Melgoard.
3. Data presented by Joe LaGrone in testimony at the July 11, 1983 Congressional hearing.
4. TVA fish data collected in June 1983 from the lower Clinch River and Watts Bar Reservoir.
5. STORET data on water and sediment collected by TVA, EPA, TNWQCD, and USGS (STORET station codes: 475775, 475780, 475115, 476031, 475784, 475325, 476032, 475639, 475638, 475776, 476105, 476012, 510213, 510174, 475910, 03538000, 03535912, 03538160, 000680, and 019002).
6. TVA 1976 study of sediment in the vicinity of the Clinch River Breeder Reactor Project.
7. Recent (June 16-July 31) DOE data on mercury concentrations in soil, sediment, water, and vegetables in the Oak Ridge area.
8. TVA Division of Occupational Health and Safety, "Update of Preconstruction Radioactivity Levels in the Vicinity of the Proposed Clinch River Breeder Reactor Project," August 1981.
9. Oakes, T. W.; Kelly, B. A.; Ohnesorge, W. F.; Eldridge, J. S.; Bird, J. C.; Shank, K. E.; Tsakeres, F. S.; Technical Background Information for the Environmental and Safety Report, Vol 4: White Oak Lake and Dam, National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161, March 1982.
10. Oakes, T. W.; Ohnesorge, W. F.; Eldridge, J. S.; Scott, T. G.; Parsons, D. W.; Hubbard, H. M.; Sealand, O. M.; Shank, K. E.; Eyman, L. D.; Technical Background Information for the Environmental and Safety Report, Vol. 5: The 1977 Clinch River Sediment Survey - Data Presentation; National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161.
11. Oakes, T. W.; Shank, K. E.; Radioactive Waste Disposal Areas and Associated Environmental Surveillance Data at Oak Ridge National Laboratory, National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161.
12. Y-12 Plant Site Oak Ridge, Tennessee, Environmental Assessment, National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161, December 1982.

PARAMETERS EXAMINED

WATER/SEDIMENT/FISH WATER ONLY RADIOLOGICAL

MERCURY	IRON	CESIUM
CADMIUM	CYANIDE	PLUTONIUM
CHROMIUM	HARDNESS	STRONTIUM
COPPER	BOD	THORIUM
LEAD	COD	URANIUM
NICKEL	TDS	
ZINC	NO _x	
PCB		
	ALUMINUM	
	BERYLLIUM	
	MANGANESE	

NUMBER OF SAMPLES

<u>PARAMETER</u>	<u>FISH</u>	<u>SEDIMENT</u>	<u>WATER</u>
MERCURY	1991 ^a	195	280
CADMIUM	388 ^b	103	233
CHROMIUM	391 ^b	132	273
COPPER	391 ^b	128	181
LEAD	392 ^b	122	225
NICKEL	391 ^b	131	148
ZINC	391 ^b	129	222
PCB	325 ^b	33	—
ALUMINUM	—	122	—
BERYLLIUM	—	17	43
MANGANESE	—	120	227
TOXIC ORGANICS	—	—	—

^a Data for 44 species (522 bluegill, 214 carp samples, 155 largemouth bass, 116 gizzard shad).

^b Data for 17 species (96 gizzard shad, 68 bluegill, 64 white bass, 33 largemouth bass), primarily from 357 ORNL samples collected in 1977 from Poplar Creek and the lower Clinch River.

COMPARISON OF MEAN VALUES FOR VARIOUS
CHEMICAL PARAMETERS IN WATER^a

Parameter	East Fork			Poplar Creek			Lower Clinch River,			Tennessee River			Bear Creek	White Oak Creek	Clinch River and Its Tributaries ^c
	15-10		10-5	6-3		3-0	12-2		565-530		8-0	2-0			
Mercury ($\mu\text{g/L}$)	<0.85	0.70	-	<12.0	<1.1	0.43	<0.20	<0.18	<0.55	<1.0	<3.0	<1.0	<0.23		
Cadmium ($\mu\text{g/L}$)	<3.2	-	-	<4.1	<3.8	<2.32	-	-	-	-	-	-	<0.37		
Chromium ($\mu\text{g/L}$)	55.0	17.0	-	<8.0	<10.7	4.79	-	-	-	-	-	-	<31.3	<3.07	
Copper ($\mu\text{g/L}$)	-	-	-	-	-	30.0	6.05	-	-	-	-	-	<16.7	<20.0	
Lead ($\mu\text{g/L}$)	<14.0	-	-	<14.0	<12.7	11.2	-	-	-	-	-	-	<10.2	4.96	
Nickel ($\mu\text{g/L}$)	-	-	-	<23.8	<20.0	20.9	-	-	-	-	-	-	<50.0	<54.0	
Zinc ($\mu\text{g/L}$)	<55.0	-	-	44.0	52.7	32.8	30.7	-	-	-	-	-	28.4	84.4	
PCB ($\mu\text{g/L}$)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Aluminum ($\mu\text{g/L}$)	-	-	-	-	-	-	<0.10	<10.0	<10.0	-	-	-	-	-	
Beryllium ($\mu\text{g/L}$)	-	-	-	-	-	-	200	71.1	57.5	-	-	-	<10.0	<10.0	
Manganese ($\mu\text{g/L}$)	-	-	-	-	-	-	5900	543	431	-	-	-	280	105 ^d	
Iron ($\mu\text{g/L}$)	-	-	-	-	-	-	<2.3	<2.9	<2.7	-	-	-	3336	983	
Cyanide ($\mu\text{g/L}$)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hardness (mg/L)	-	-	-	-	-	-	63.0	119.0	66.0	81.0	32.0	-	71.0		
BOD ₅ (mg/L)	-	-	-	-	-	-	-	1.6	1.3	2.9	-	-	1.9	1.6	
COD (mg/L)	-	-	-	-	-	-	-	17.0	11.6	6.7	-	-	17.5	11.6	
TDS (mg/L)	205	-	-	-	-	-	188	169	156	-	-	-	-	166	
NO ₂ +NO ₃ (mg/L)	-	-	-	-	-	-	0.37	0.45	0.34	-	-	-	0.22	0.54	
pH	7.8	7.6	7.5	-	-	6.5	7.6	7.7	7.4	6.7	-	-	6.9	7.7 ^e	

a. Numbers given are averages of the available data, 1970-1983, in each basin reach.

b. Numbers indicate the river mile reaches.

c. Rivers and streams tributary to the Clinch River upstream of Melton Hill Dam; 12 sampling locations - 1970-1981, TVA/STORET data.

d. Atypical data in the Ollis Creek watershed (a surface, strip-mined area) are not included.

e. Atypical data in the Ollis Creek watershed and Norris Reservoir are not included.

COMPARISON OF MEAN VALUES FOR VARIOUS
CHEMICAL PARAMETERS IN SEDIMENT^a

Parameter	East Fork Poplar Creek ^b			Poplar Creek			Lower Clinch River			Tennessee River			Bear Creek		White Oak Creek		Clinch River and Its Tributaries ^c	
	15-10	10-5	5-0	6-3	3-0	10	565-530	10	565-530	8-0	4-0	8-0	4-0	8-0	4-0	8-0	4-0	
Mercury	45.6	24.0	21.9	13.1	10.0	6.39		1.24		2.03		2.05					<0.16	
Cadmium	<400	-	<83.2	<4.55	<4.46	<4.0		1.13		<400		0.65					1.43	
Chromium	150	76.0	75.1	92.5	111	69.5		25.7		<100		6.5					19.3	
Copper	135	-	64.4	81.4	73.6	29.2		7.8		50		8.9					18.2	
Lead	-	-	41.5	40.7	52.5	23.1		52.7		-		20.0					31.6	
Nickel	<100	-	76.9	178	139	32.4		25.2		<100		6.5					30.5	
Zinc	<800	-	190	113	127	57.8		85.0		<1350		48.0					69.6	
PCB	0.21	-	1.74	4.29	5.34	-		-		-		1.05					-	
Aluminum	76250	-	45714	40372	48866	34917		3000		45000		-					7452	
Beryllium	<10	-	<10	-	<0.60	-		<0.60		<10		<0.60					<1.0	
Manganese	-	-	584	588	593	624		670		-		1255					1093	

a. Numbers given are averages of the available data, 1970-1983, in each basin reach. All concentrations given in $\mu\text{g/g}$, dry weight (ppm).

b. Numbers indicate the stream mile reaches.

c. Rivers and streams tributary to the Clinch River upstream of Melton Hill Dam (CRM 23.1); 12 sampling locations - 1970-1981, TVA/STORET data.

COMPARISON OF MEAN VALUES FOR VARIOUS CHEMICAL
PARAMETERS IN FISH IN POPLAR CREEK^a

<u>Parameter^b</u>	<u>Bluegill</u>	<u>LM Bass</u>	<u>Giz. Shad</u>	<u>Lepomis</u>	<u>Chan. Cat.</u>	Approximate Range of Background ^c Concentrations	FDA Action Level
Mercury	0.31	0.59	0.04	0.43	0.39	0.05-0.20	1.0
Cadmium	0.02	0.01	0.01	0.02	0.01	0.02-0.07	-
Chromium	0.16	0.19	0.07	0.03	0.33	0.03-0.10	-
Copper	0.40	0.45	0.87	0.23	0.58	0.15-0.90	-
Lead	0.06	0.10	0.08	0.10	0.12	0.03-0.70	d
Nickel	0.78	0.56	1.28	0.66	1.42	0.20-0.60	-
Zinc	8.7	8.1	3.9	7.1	5.3	5-10	d
PCB	0.17	0.38	0.27	0.30	1.6	<0.10	5.0

a. Numbers given are averages of the available data, 1976-1983.

b. All concentrations given in $\mu\text{g/g}$ (ppm).

c. Based primarily on the State-wide mean concentrations for trace metals in fish (Sinclair et al., 1979) and on average concentrations in Melton Hill Reservoir at CRM 52.2.
d. The U.S. Food and Drug Administration (FDA) has no recommended action level for lead or zinc, but the Canadian Food and Drug Directorate has set standards of 10 and 100 ppm, respectively, for these metals.

COMPARISON OF MEAN VALUES FOR VARIOUS CHEMICAL PARAMETERS
IN FISH IN THE LOWER CLINCH RIVER BELOW MELTON HILL DAM^a

<u>Parameter^b</u>	<u>Bluegill</u>	<u>LM Bass</u>	<u>Giz. Shad</u>	<u>Lepomis</u>	<u>Approximate Range of Background Concentrations^c</u>	<u>FDA Action Level</u>
Mercury	0.30	0.23	0.05	0.37	0.05-0.20	1.0
Cadmium	0.01	0.01	0.01	0.01	0.02-0.07	-
Chromium	0.05	0.08	0.17	0.03	0.03-0.10	-
Copper	0.25	0.33	0.63	0.30	0.15-0.90	-
Lead	0.07	0.12	0.10	0.14	0.03-0.70	d
Nickel	0.72	0.55	0.51	0.60	0.20-0.60	-
Zinc	6.4	5.8	4.1	11.1	5-10	d
PCB	-	0.20	0.22	0.15	<0.10	5.0

- a. Numbers given are averages of the available data, 1976-1983.
- b. All concentrations given in $\mu\text{g/g}$ (ppm).
- c. Based primarily on the State-wide mean concentrations for trace metals in fish (Sinclair et al., 1979) and on average concentrations in Melton Hill Reservoir at CRM 52.2.
- d. The U.S. Food and Drug Administration (FDA) has no recommended action level for lead or zinc, but the Canadian Food and Drug Directorate has set standards of 10 and 100 ppm, respectively, for these metals.

CRITERIA AND SELECTED DATA FOR
CHEMICAL PARAMETERS IN WATER

Parameter (Units)	TN Source Standards ^a	EPA Drinking Water Standards ^{b,c}	Mean Concentrations of Tributary Streams to Upper Tennessee River	
			24-hr Avg	Aquatic Life ^d Maximum
Temperature (°C)	30	-	-	-
Dissolved oxygen (mg/L)	-	-	5.0 ^f	15.0
pH (standard units)	6-9	6.5-8.5	6.5-9.0	8.8
Conductance, (μmhos/cm)	-	-	-	6.9
Turbidity (NTU)	-	-	-	192
Total dissolved solids (mg/L)	500	1	-	9.5
Ammonia nitrogen (mg/L as N)	-	500	500	101
Nitrite + nitrate nitrogen (mg/L as N)	10 (as NO ₃ -N)	10 (as NO ₃ -N)	-	0.09
Total organic carbon (mg/L)	-	-	-	0.39
Total phosphorus (mg/L)	-	-	-	2.87
Chloride (mg/L)	250	250	-	0.04
Sulfate (mg/L)	250	250	-	3.9
Fluoride (mg/L)	-	1.6	-	20.6 ^j
Aluminum (μg/L)	-	-	-	0.07
Arsenic (μg/L)	50	50	-	761
Barium (μg/L)	1,000	1,000	-	<3.9
Beryllium (μg/L)	-	-	-	<100
Boron (μg/L)	-	-	-	<10
Cadmium (μg/L)	10	10	-	246
Chromium (μg/L)	50	50 ⁱ	0.025 ^h	<1.8
Cobalt (μg/L)	50	-	-	<4.2
Copper (μg/L)	1,000	1,000	5.3	21.6
Iron (μg/L)	-	300	-	47
Lead (μg/L)	50	50	0.025 ^h	853
Lithium (μg/L)	-	-	3.8 ^h	<16.8
Manganese (μg/L)	-	50	-	<10
Mercury (μg/L)	0.2	2	5.6	110 ^j
Molybdenum (μg/L)	-	-	5.6	<0.4
Nickel (μg/L)	100	-	1,000 ^h	-
Selenium (μg/L)	10	10	3.8 ^h	-
Silver (μg/L)	50	50	-	-
Vanadium (μg/L)	-	-	4.1 ^h	-
Zinc (μg/L)	5,000	5,000	47	<322
Cyanide (mg/L)	200	-	320 ^h	126
			3.5	<0.01

- a. Tennessee Drinking Water Source Standards, 1983.
- b. National Interim Primary Drinking Water Standards, 40 CFR Part 141.
- c. National Secondary Drinking Water Standards, 40 CFR Part 143.
- d. EPA Water Quality Criteria for the Protection of Aquatic Life. Criteria listed are from EPA's Quality Criteria for Water (1976) ("Red Book") and from EPA's 1980 Water Quality Criteria for Priority Pollutants (see 45 FR 79318-79341, November 28, 1980).
- e. Average concentrations in water for streams tributary to the Tennessee River between miles 424 and 652; 43 sampling locations - TVA STORET data.
- f. The 5.0 mg/L criteria for dissolved oxygen is a minimum value rather a 24-hour average.
- g. 0.02 as unionized ammonia. See EPA's 1976 Quality Criteria for Water, p. 16 for further explanation.
- h. Values calculated for a hardness of 100 mg/L using the equations given in 45 FR 79318-341. Increasing hardness generally decreases toxicity of these metals.
- i. National Interim Primary Drinking Water Standard is 50 μg/L for hexavalent chromium (Cr⁺⁶). The criteria listed for aquatic life, irrigation, and livestock are for total chromium, which was the species measured in this study.
- j. Atypical data from the Ollis Creek watershed (a surface, strip-mined area) were not included.

TABLE 9

CRITERIA AND SELECTED DATA FOR
CHEMICAL PARAMETERS IN SEDIMENT AND SOIL

Parameter ^a Proposed Virginia Criteria ^b (ppm)	Average Earth's Crust ^c	Mean Concentrations of Upper Tennessee River	Mean Concentrations of Tributary Streams to Upper Tennessee River ^e		Mean Concentrations of Clinch River ^f
			to Upper Tennessee River ^e	to Clinch River ^f	
Mercury	0.3	0.5	1.0 (<0.05-4.3)	0.25 (<0.05-0.98)	<0.16 ^g (<0.05-0.41)
Cadmium	-	0.2	5.5 (0.4-12.0)	1.8 (<0.4-11.0)	1.4 (<0.4-3.7)
Chromium	-	200	48.0 (14.0-86.0)	19.7 (5.0-46.0)	19.3 (6.3-44.7)
Copper	-	70	38.0 (5.9-67.0)	47.6 (3.0-320.0) ^h	18.2 (3.0-48.0)
Lead	-	16	59.7 <td>47.9 (<3.0-300.0)</td> <td>31.6 (13.1-72.0)</td>	47.9 (<3.0-300.0)	31.6 (13.1-72.0)
Nickel	-	100	33.6 (5.8-57.0)	22.4 (<3.3-70.0)	30.0 (16.0-70.0)
Zinc	-	80	670 (85-1,600)	165 (20-940)	69.6 (31.6-140)
PCBs	-	-	-	-	-
Aluminum	-	81,000	25,590 (3,000-46,000)	8,684 (1,200-21,000)	7,453 (2,720-13,700)
Beryllium	-	6	1.9 <td>0.93 (<0.6-1.9)</td> <td><1.0 (<0.7-1.0)</td>	0.93 (<0.6-1.9)	<1.0 (<0.7-1.0)
Manganese	-	1,000	2,619 (670-5,300)	1,133 (150-14,000)	1,093 (442-3,100)

- a. Concentrations given in mg/kg (ppm), dry weight, range in parenthesis.
- b. State of Virginia proposed regulation for total mercury in freshwater river sediment.
- c. After V. M. Goldschmidt. Courtesy A. Muir, editor, and Clarendon Press, Oxford, publishers of "Geochemistry," average abundance of trace elements in the crust of the earth.
- d. Average concentrations in river sediment for reach from Nickajack Dam to confluence of the Holston and French Broad Rivers, TRMs 424 to 652; 24 sampling locations - 1970 to 1983, TVA STORET data.
- e. Average concentrations in river sediment for streams tributary to the Tennessee River between miles 424 and 652; 43 sampling locations 1970 to 1981, TVA STORET data.
- f. Average concentrations in Clinch River sediment above Melton Hill Dam, CRM 22; 12 sampling locations - 1970 to 1981, TVA STORET data.
- g. Seven of twelve samples below detection limits.
- h. Ocoee River - downstream of Copperhill, Tennessee.

CRITERIA AND SELECTED DATA FOR
CHEMICAL PARAMETERS IN FISH

Parameter ^a	FDA Criteria ^b (ppm)	Tennessee State-Wide Mean	Melton Hill Reservoir ^d CRM 52.2	Great Smoky Mountains National Park ^e		Skinface Pond f	Cayuga Lake New York ^g	Wintergreen Lake Illinois ^h	Hybrid Sunfish
				Bluegill	Rainbow Trout				
Mercury	1.0	0.28	0.06 (0.03-0.08)	0.036 ⁱ (0.003-0.177)	-	-	-	0.468 (0.189-0.899)	0.255 (0.136-0.382)
Cadmium	-	0.07	0.018 (0.001-0.042)	-	-	-	-	-	-
Chromium	-	0.11	0.030 (0.022-0.044)	-	-	-	-	-	-
Copper	-	0.87	0.16 (0.06-0.30)	-	-	0.22 (0.09-0.50)	0.12 (0.07-0.22)	0.022 (0.015-0.036)	-
Lead	-	0.70	0.027 (0.017-0.042)	-	-	0.1 ^j (<0.1-0.4)	0.3 ^j (<0.1-1.1)	0.011 (0.004-0.022)	0.198 (0.170-0.445) (0.030-0.444)
Nickel	-	-	0.40 (0.23-0.65)	-	-	-	-	0.014 (0.007-0.023)	-
Zinc	-	-	5.4 (4.5-7.5)	-	-	2.5 (1.4-4.9)	6.3 (2.5-9.7)	0.210 (0.035-0.048)	-
PCBs	5.0	-	-	-	-	-	-	-	-
Aluminum	-	-	-	-	-	-	-	-	-
Beryllium	-	-	-	-	-	-	-	-	-
Manganese	-	-	-	-	-	-	-	-	-

- a. Concentrations given $\mu\text{g/g}$ (ppm), wet weight, range in parentheses.
- b. The Food and Drug Administration recommends a criterion of 1.0 ppm and 5.0 ppm for mercury and PCBs, respectively, in fish flesh.
- c. Sinclair, et al. (1979). Heavy Metals Concentrations in Fish Tissue in Tennessee (1977-78). Tennessee Department of Public Health, Division of Water Quality Control.
- d. Loar, et al. (1981). Description of the Aquatic Ecology of White Oak Creek Watershed and the Clinch River Below Melton Hill Dam. ORNL Report TM-7509/V2.
- e. Huckabee, et al. (1974). "Mercury Concentrations in Fish from the Great Smoky Mountains National Park." Anal. Chim. Acta 70:41-47. No size/age data reported.
- f. Wiener and Giesy. (1979). "Concentrations of Cd, Cu, Mn, Pb, and Zn in Fishes in a Highly Organic Softwater Pond." J. Fish. Res. Board Canada 36:270-279. Wet wt. of fish ranged from 51.3 to 1191.8 g and 97.7 to 351.2 g for largemouth bass and bluegill, respectively.
- g. Tong, et al. (1974). "Trace Metals in Lake Cayuga Lake Trout (*Salvelinus namaycush*) in Relation to Age." J. Fish. Res. Board Canada 31:238-239. Composite sample of three decapitated and eviscerated fish was analyzed for each of 12 age classes.
- h. Mathis and Kevern. (1975). "Distribution of Mercury, Cadmium, Lead, and Thallium in a Eutrophic Lake." Hydrobiologia 46:207-222.
- i. Value based on both axial and whole body determinations.
- j. Whole body concentration. Wet wt. of fish ranged from 0.34 to 69.36 g and 0.03 to 20.58 g for largemouth bass and bluegill, respectively.

TABLE 11

SUMMARY OF CONCLUSIONS REGARDING CONCENTRATIONS IN FISH, SEDIMENT, AND WATER

PARAMETER	SIGNIFICANTLY ABOVE BACKGROUND LEVELS			INADEQUATE DATA			NOT SIGNIFICANTLY ABOVE BACKGROUND CONCENTRATIONS		
	Fish ^b	Sediment	Water	Fish ^b	Sediment	Water	Fish ^b	Sediment	Water
MERCURY	●	●			●	●			
CADMIUM ^a	●								
CHROMIUM	●	●	●						
COPPER	●			●		●			
LEAD	●	●		●		●			
NICKEL	●	●		●					
ZINC				●		●	●	●	●
PCB	●			●					
ALUMINUM			●			●			
BERYLLIUM ^a				●		●			
MANGANESE				●			●		●
TOXIC ORGANICS						●			

^a Detection limit problems, especially with older data.

^b Comparisons for all parameters except mercury are based on data from Poplar Creek and the lower Clinch River.

COMPARISON OF AVERAGE CONCENTRATIONS FOR SELECTED PARAMETERS IN SEDIMENT

<u>LOCATION</u>	<u>RIVER MILES</u>	<u>MERCURY</u>	<u>CHROMIUM</u>	<u>COPPER</u>	<u>LEAD</u>	<u>NICKEL</u>
EAST FORK	10-15	45.6	150	135	—	<100
POPLAR CREEK	5-10	24.0	76	—	—	—
	0-5	21.9	75.1	64.4	41.5	76.9
POPLAR CREEK	3-6	13.1	92.5	81.4	40.7	178
	0-3	10.0	111	73.6	52.5	139
CLINCH RIVER	10	6.39	69.1	29.2	23.1	32.4
TENNESSEE RIVER (530- 565)		1.24	25.7	7.80	52.7	25.2
BEAR CREEK (0-8)		2.03	<100	50	—	<100
WHITE OAK CREEK (0-4)		2.05	6.5	8.9	20.0	12.5
CLINCH RIVER AND ITS TRIBUTARIES ^b		<0.16	19.3	18.2	31.6	30.5

a Numbers given are averages of the available data, 1970-1983, in each basin reach. All concentrations given in $\mu\text{g/g(ppm)}$.

b Rivers and streams tributary to the Clinch River upstream of Melton Hill Dam (CRM 23.1); 12 sampling locations - 1970 to 1981, TVA/STORET data.

**COMPARISON OF AVERAGE CONCENTRATIONS
FOR SELECTED PARAMETERS IN FISH
FROM POPLAR CREEK^a**

<u>SPECIES</u>	<u>MERCURY</u>	<u>CHROMIUM</u>	<u>NICKEL</u>	<u>PCB</u>
BLUEGILL	0.31	0.16	0.78	0.17
LM BASS	0.59	0.19	0.56	0.38
GIZZARD SHAD	0.04	0.07	1.28	0.27
LEPOMIS	0.43	0.03	0.66	0.30
CHANNEL CATFISH	0.39	0.33	1.42	1.6
APPROXIMATE RANGE OF BACKGROUND CONCENTRATIONS ^b	(0.05-0.20)	(0.03-0.10)	(0.20-0.60)	< 0.10

^a Numbers given are averages of the available data, 1976-1983. All concentrations given in µg/g(ppm).

^b Based primarily on state-wide mean concentrations for trace metals in fish (Sinclair *et al.*, 1979) and on average concentrations in Melton Hill Reservoir at CRM 52.2

MERCURY CONCENTRATIONS IN SEDIMENTS OF THE UPPER TENNESSEE RIVER*

<u>RESERVOIR</u>	<u>RIVER REACH SAMPLED</u>	<u>NUMBER OF SAMPLES</u>	<u>MEAN CONCENTRATION ($\mu\text{g/g}$)</u>
FORT LOUDOUN/WATTS BAR (CLINCH RIVER)	TRM 650.0-579.0 TRM 567.7	10 —	0.27 —
WATTS BAR	TRM 560.8-531.0	4	1.09
CHICKAMAUGA	TRM 508.0-472.3	15	1.75
NICKAJACK	TRM 459.0-425.5	10	0.53

*Approximate range of background concentrations in unpolluted waters of the Tennessee Valley
 = $0.1\text{-}0.3 \mu\text{g/g}$

Mercury Analysis of Soils in the Oak Ridge Area

<u>Location</u>	<u>No. of Samples</u>	<u>Mean Conc.</u> ($\mu\text{g/g}$)	<u>Standard Deviation</u>
1. Greenview Estates	16	8.31	10.4
2. Robertsville Jr. High	12	14.1	12.10
3. YWCA	7	0.23	0.05
<u>Robertsville, Jr. High Area</u>			
4. Valparaiso Road	1	10.4	-
5. Victoria Road	3	0.048	0.025
6. Hollywood Road	1	0.046	-
<u>East Fork Poplar Creek Area</u>			
7. Big Turtle Park/Wiltshire Boulevard	12	0.243	0.234
Wiltshire Sewer Beltway	5	32.8	20.8
8. Gum Hollow Road/Greystone Lane	4	0.571	0.331
9. Between Greenview Estates and Jefferson Avenue - Including Floodplain	17	11.8	30.1
10. <u>Background</u>			
a. Freels Bend	3	0.117	0.076
b. Union Road	5	0.08	0.027
c. Lamberts Quarry - Noncontaminated	4	0.063	0.025
d. Raccoon Creek	1	0.004	-
11. Jefferson Jr. High	6	11.4	15.5
12. Jefferson Jr. High Area - Includes Sewer Belt	22	125	93.2
13. Warehouse Road Bellgrade Road Colgate Road	11	15.1	44.9
14. Scarboro Area	33	3.37	16.8
15. ORNL	19	1.66	3.01

APPENDIX III - List of June 14, 1983 Data Received

Recd 6/14/83



Department of Energy
Oak Ridge Operations
P.O. Box E
Oak Ridge, Tennessee 37830

June 14, 1983

Tennessee Valley Authority
ATTN: Mr. Jack Milligan
Water Quality Control Branch
401 Building
Chattanooga, Tennessee 37401

Gentlemen:

REQUEST FOR INFORMATION

Reference is made to Mr. A. D. McKinney's letter dated May 16, 1983, subject as above, copy to you. As requested in his letter, enclosed is the data related to mercury in the environment.

There were three items on the TN/DPH list that I was unable to identify (marked by red "stars"). I am requesting copies of these from Mr. McKinney. If they are different from the information attached, I will forward these to you as soon as possible.

If you have any questions or need any additional information, you can contact me at (615) 576-0845.

Sincerely,

A handwritten signature in black ink that reads "J. F. Wing".

J. F. Wing, Chief
Environmental Protection Branch
Safety and Environmental Control Division

SE-331:BLQ

Enclosures:
As stated

cc w/o encl:
A. D. McKinney, TN/DPH

Rec'd 6/2/83.



STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH
EAST TENNESSEE REGIONAL OFFICE
ALEX B. SHIPLEY REGIONAL HEALTH CENTER
1522 CHEROKEE TRAIL
KNOXVILLE, TENNESSEE 37920

May 16, 1983

Mr. J. F. Wing, Chief
Environmental Protection Branch
Department of Energy
P.O. Box E
Oak Ridge, TN 37830

Re: Request for Information

Dear Mr. Wing:

At a meeting in our office last October, you presented us with data concerning environmental monitoring in the Oak Ridge area. Included was a report with a cover letter dated October 26, 1982, containing the heading "Submission of DOE Acquired Data Relating to Metals and Organics Levels in Local Fishery and Sediments." This report included four pages listing documents used as references.

We have compared those lists with documents submitted and find we do not have all that are needed to fully assess the situation in question. Some documents were submitted only in part and others apparently omitted. It is possible that titles in the listing do not exactly match those of documents on hand, and thus, we may think them to have been omitted.

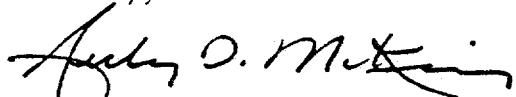
Enclosed you will find copies of lists from your report. Please submit to this office complete copies of those documents marked by an asterisk. Also enclosed is a catalogue of all documents we do have in their complete form. We request that a copy of each of these along with a copy of each of the documents marked on the first lists be sent to the following address:

Jack Milligan, Tennessee Valley Authority
Water Quality Control Branch
401 Building
Chattanooga, TN 37401

Mr. J. F. Wing, Chief
Page 2
May 16, 1983

Please call if you have any questions regarding this request for information.

Sincerely,



Aubrey D. McKinney, Manager
Knoxville Basin Office
Division of Water Management

ADM/BWS/kav A/17

cc: Jack Milligan, TVA ✓

Preliminary Study, Mercury Contamination In East Fork Poplar Creek and Bear Creek, 1982

- * Mercury in Fish 1978 - Fish From: Melton Hill, East Fork Poplar Creek, Clinch River, Rogers Quarry, and New Hope Pond *Need*
- * Fish Analysis 1977 - Mercury Heavy Metals
- Mercury in Fish 1977 - Poplar Creek, Clinch River
- Mercury in Fish 1977 - Popular Creek
- * East Fork Poplar Creek 1970-1976
- * Mercury Content of Fish Samples 1976, Poplar Creek, Melton Hill Lake
- Mercury in Fish 1976, Melton Hill Lake, Clinch River, Poplar Creek
- Mercury in Fish, Poplar Creek 1976
- Mercury Fish, Clinch River 1976
- Preliminary Aquatic Survey East Fork Poplar Creek and Bear Creek, 1975
- Preliminary Aquatic Survey of East Fork Poplar Creek and Bear Creek 1974
- Preliminary Aquatic Survey of East Fork Poplar Creek and Bear Creek 1973
- Aquatic Survey East Fork Poplar Creek and Bear Creek 1973
- Preliminary Aquatic Survey of East Fork Poplar Creek and Bear Creek, 1972

* - Need Copy

ORNL Drawing 81-9373

ORNL Drawing 81-9374

* Clinch River Sediment Data - Appendix A

ORNL/TM-6714-1981 - Ecological Studies of the Biotic Communities in the Vicinity of the Oak Ridge Gaseous Diffusion Plant

Y/UB-16 - Environmental Monitoring Report, U.S.DOE, Oak Ridge Facilities, Calendar Year 1981

Y/UB-15 - Environmental Monitoring Report, U.S.DOE, Oak Ridge Facilities, Calendar Year 1980

1981
ORNL/TM-7509/V2-~~1979~~ - Technical Background Information for the ORNL Environmental and Safety Report, Volume 2

Y/UB-13 - Environmental Monitoring Report, U.S.DOE, Oak Ridge Facilities, Calendar Year 1979

ORNL/TM-6895-1978 - Association of Radionuclides with Streambed Sediments in White Oak Creek Watershed

Y/UB-10 - Environmental Monitoring Report, U.S.DOE, Oak Ridge Facilities, Calendar Year 1978

Y/UB-8 - Environmental Monitoring Report, U.S.DOE, Oak Ridge Facilities, Calendar Year 1977

Y/UB-6 - Environmental Monitoring Report, U.S.ERDA, Oak Ridge Facilities, Calendar Year 1976

ORNL-5169 - Applied Health Physics and Safety Annual Report for 1975

Y/UB-4 - Environmental Monitoring Report, U.S.ERDA, Oak Ridge Facilities, Calendar Year 1975

* ORNL-5055 - Applied Health Physics and Safety, Annual Report for 1974

* UCC-ND-302 - Environmental Monitoring Report, U.S.ERDA, Oak Ridge Facilities, Calendar Year 1974

ORNL-4974 - Applied Health Physics and Safety, Annual Report for 1973

* UCC-ND-280 - Environmental Monitoring Report, U.S.AEC, Oak Ridge Facilities, Calendar Year 1973

ORNL-4894 - Applied Health Physics and Safety, Annual Report for 1972

ORNL-4848 - Environmental Sciences Division, Annual Progress Report, Period Ending September 30, 1972

- * ORNL-4795 - Applied Health Physics and Safety, Annual Report 1971
- * ORNL-4445-UC-48-Biology and Medicine
- * ORNL-4423-UC-41-Health and Safety, Applied Health Physics and Safety Annual Report for 1968
- * ORNL-4316, UC-41-Health and Safety, Health Physics Division, Annual Progress Report for Period Ending July 31, 1968
- * ORNL-4286-UC-41-Health and Safety, Health Physics and Safety, Annual Report for 1967
- ORNL-4035-UC-70-Waste Disposal and Processing-1967, Clinch River Study
- ORNL-3721, Supplemental 2B, UC-70-Waste Disposal and Processing, 1967, Radioactive Materials in Bottom Sediment of Clinch River: Part B, Inventory and Vertical distribution of Radionuclides in Undisturbed Cores
- ORNL-3721, Supplement 2A, UC-70-Waste Disposal and Processing, Radioactive Materials in Bottom Sediment of Clinch River: Part A, Investigations of Radionuclides in Upper Portion of Sediment
- * ORNL-4007-UC-41-Health and Safety, Health Physics Division Annual Progress Report for Period Ending July 31, 1966
- * ORNL-4146-UC-41-Health and Safety, Health Physics and Safety Annual Report for 1966
- * ORNL-3969-UC-41-Health and Safety, Health Physics and Safety Annual Report for 1965
- * ORNL-3849-UC-41-Health and Safety TID-4500 (44th ed.), Health Physics Division Annual Progress Report for Period Ending July 31, 1965
- ORNL-3721, UC-70-Waste Disposal and Processing, TID-4500 (44th ed.), 1965, Status Report No. 5 on Clinch River Study
- * ORNL-3820-UC-41-Health and Safety, TID-4500 (41st ed.), Applied Health Physics Annual Report for 1964
- * ORNL-3697, UC-41-Health and Safety, TID-4500 (34th ed.), Health Physics Division Annual Progress Report for Period Ending July 31, 1964
- * ORNL-3665-UC-41-Health and Safety, TID-4500 (31st ed.), Applied Health Physics Annual Report for 1963
- * ORNL-3492-UC-41-Health and Safety, TID-4500 (22nd ed.), Health Phsycis Division Annual Progress Report for Period Ending June 30, 1963
- ORNL-3409,UC-70-Waste Disposal and Processing, TID-4500 (21st ed.), 1963, Status Report No. 4 on Clinch River Study

D.O.E. Publications
Re: Fish and Sediments Clinch River and Poplar Creek Systems

1970

Date: August 6, 1970
Title: Mercury Analysis - Cover Corresp. M. Sanders to J.D. McLendon
Source: Union Carbide - Radiation Safety Dept. (Y-12?) - 2373 - Carbide
I.D. #: 2373?
Contents: Mercury Analysis in fish, water and mud
New Hope, EFPC, Bear Cr., Melton Hill

1972

Date: September 1972
Title: Preliminary Aquatic Survey of EFPC & BC - 1972
Source: AEC - Gail McClain - summer student project
I.D. #: None
Contents: Fauna, pH, D.O., Silt. Deposits - general observations

1973

Date: Spring 1973
Title: Aquatic Survey EFPC & BC
Source: Scott Wing & Fred Needham (students)
I.D. #: None
Contents: DO, pH, nutrients, Cl₂, - general observation EFPC & BC

Date: September 1973
Title: Preliminary Aquatic Survey of EFPC & BC
Source: John Reece - AEC Environmental Protection Branch
I.D. #: None
Contents: Chemical & Physical Data on EFPC & BC - Sediments

1974

Date: September 1974
Title: Preliminary Aquatic Survey EFPC & BC
Source: AEC - Envir. Prot. Branch - John Reece
I.D. #: None
Contents: Sediment and Water Data incl. Pu, U, Th, Hg & Rad levels
EFPC, BC, Clinch, Oak Ridge General

Date: November 1974
Title: Bottom Sediment Data for Stream & Ponds on OR DOE Reservations
Source: AEC - Cover Corresp. RG Jordon, AEC Safety & Envir. Branch to AEC's
W'm Travis
I.D. #: None
Contents: PCB Sediment Data New Hope, Y-12 Sludge Pond, EFPC, PC, K-25,
Clinch River, White Oak

1975

Date: 1975
Title: Environmental Monitoring Report
Source: ERDA - OR - Carbide
I.D. #: Y/UB-4
Contents: Annual Report w/Fish Rad Data (Avg.) Clinch R. and Melton Hill & P.C.
Metals in Sediment Data

Date: 1975
Title: Applied Health Physics & Safety Annual Report
Source: ORNL
I.D. #: ORNL-5169
Contents: Aug. Rad Fish Data in Clinch River - refers to Table 4.41, page 52
U & Pu in soils - (not included)

Date: September 1975
Title: Preliminary Aquatic Survey of EFPC & BC
Source: ERDA Env. Protection Branch - John Reece - ORO
I.D. #: None
Contents: DO, NH₃, NO₂, General Physical Data EFPC & BC

1976

Date: Summer, Fall 1976
Title: Mercury in Fish
Source: Unknown (Abee?)
I.D. #: None
Contents: Hg levels in fish from Clinch, Poplar Creek, Melton Hill

Date: Calendar Year 1976
Title: Envir. Monitoring Report
Source: Carbide
I.D. #: Y/UB-6
Contents: Rad in Fish in Clinch & Melton Hill
Avg. Stream Sediment Data for Heavy Metals P.C. & Clinch

Date: October 1, 1976
Title: Fish Analysis
Source: Unknown
I.D. #: None
Contents: U, Th, PCB, Hg data for fish from Kerr Hollow, Loudon Lake, Rogers Quarry,
Poplar Creek

Date: 1976
Title: Clinch River & Poplar Creek Fish Sampling Data
Source: ORNL - Cover Corres. J. Elwood to Michael Ellis, K-25
I.D. #: None
Contents: Summary Report of 1976 Hg. in Fish Studies

1977

- Date: June 6, 1977
Title: Mercury Contamination in Poplar Creek and Clinch River
Source: ORNL
I.D.#: ORNL/CF-77/320
Contents: Fish & Sediment Data/EFPC, PC, Bear Creek, Clinch River
- Date: June 21, 1977
Title: Environmental Monitoring Report
Source: DOE
I.D.#: Y/UB-8
Contents: Calendar Year Environmental Monitoring Air, Water, Sediments, Biological, Dose Calculations - Metals & RAD
- Date: July 8, 1977
Title: Draft - Mercury Contamination of Poplar Creek and Clinch River
Source: ORNL - Cover correspondence Brooks to Hart
I.D.#: TVA Correspondence 3822
Contents: Mercury data - sediments
- Date: May 6, 1977
Title: Mercury in Fish in Poplar Creek
Source: ORNL
I.D.#: Cover Correspondence Wing to Travis
Contents: 1976 Fishery Data - Mercury
- Date: September 30, 1977
Title: Clinch River & Poplar Creek Fish Sampling Data
Source: ORNL/DOE
I.D.#: Correspondence to Loar
Contents: Fishery Data - Heavy Metals & PCB

1978

- Date: July 31, 1978
Title: Summary Correspondence
Source: DOE - ORO/TVA - DEP Concerning Mercury in Poplar Creek
I.D.#: DOE
Contents: Fishery Data & Heavy Metals & PCB
- Date: October 4, 1978
Title: Fishery Data - Melton Hill, Clinch River, Poplar Creek, Rogers Quarry, New Hope Pond
Source: DOE
I.D.#:
Contents: Fishery - Mercury - Data
- Date: Calendar year 1978
Title: Environmental Monitoring Report
Source: DOE
Contents: Air, Water, Sediments, Biological, Dose Calculations - Metals & RAD
I.D.#: Y/UB-10

Date: August 18, 1978
Title: Clinch River Fishery Data (Mercury)
Source: TWQC
I.D. #:
Contents: Mercury in Fish Flesh & Organs Clinch River

1979

Date: December of 1979
Title: Environmental Assessment of Oak Ridge Gaseous Diffusion Plant
Source: DOE
I.D. #: DOE/EA-0106
Contents: Water Quality & Sediment Data Metals & PCB

Date: Calendar Year 1979
Title: Environmental Monitoring Report DOE Oak Ridge Facilities
Source: DOE
I.D. #: Y/UB-13
Contents: Air - Water - Biological Monitoring Heavy Metals, Radiological

Date: April 10, 1979
Title: Clinch River & Poplar Creek
Bottom Sediments Data - Special Sampling
Source: DOE
I.D. #: K-1551, MS 127
Contents: PCB, in sediments

1980

Date: Calendar year 1980
Title: Environmental Monitoring Report
DOE Oak Ridge Facilities
Source: DOE
I.D. #: Y/UB-15
Contents: Annual Monitoring Report

1981

Date: Calendar Year 1981
Title: Environmental Monitoring Report DOE Oak Ridge Facilities
Source: DOE
I.D. #: Y-UB-16
Contents: Annual Report

Date: October 1981
Title: Ecological Studies of Biotic Communities in Vicinity of the O.R. Gaseous Diffusion Plant
Source: DOE
I.D. #: ORNL/TM-6714
Contents: Fishery and Sediment Data
Metals - Organics - (PCB) Radiological

Date: October 1981
Title: Technical background information for the ORNL Envi. and Safety Report - Volume 2
Source: ORNL
I.D. #: ORNL/TM-7509/V2
Contents: Aquatic Ecology of White Oak Watershed and Clinch River Biological Communities and Metals in Fish
1982

Date: September 7, 1982
Title: Mercury Contamination in EFPC and Bear Creek
Source: ORNL
I.D. #: ORNL/CF-82/257
Contents: Sediment/Fishery/Agriculture
Mercury Data EFPC

Date: October 8, 1982
Title: Poplar Creek Fish Sampling
Special Sampling
Source: DOE
I.D. #: K-1551, MS127
Contents: Methyl Mercury - Uranium - and 1260 (PCB) in Fish Flesh

Date: October 14, 1982
Title: Sample Site description - Poplar Creek Biological (fishery) sample
Source: DOE
I.D. #: Mitchel to VanWinkle
Contents: Sample sites only - no data
Trot lines for catfish

1983

Date: October 26, 1982
Title: Review of Mercury in Fish Data from East Fork Poplar Creek
Source: DOE
I.D. #: Correspondence Wing to McKinney
Contents: See Title

Date: March 8, 1983
Title: Y-12 - CSI - Notice of Noncompliance
Source: TWQC
I.D. #:
Contents: Statement of Environmental Problems

Date: April 22, 1983
Title: Memorandum of Understanding
EPA - DOE - TWQC
Source: EPA
I.D. #: 4PM - EA/AGL
Contents: MOV - See Correspondence